ABSTRACTS OF NORTH AMERICAN GEOLOGY

November 1968

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1968

UNITED STATES DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. Price 75 cents (single copy). Subscription price: $9.00 a year (12 monthly issues); $2.25 additional for foreign mailing. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (December 8, 1965). (exp. 12-68)

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

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ABSTRACTS

02148 **Aaker, Robert; Jedlicka, John.** Pre-Mancos gas fields in northwest Colorado, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 856–865, illus., tables, 1968.

Pre-Mancos gas fields of northwestern Colorado are on the north-plunging Douglas Creek arch and east-west-trending Axial uplift. Most of the fields produce from sandstone in the Lower Cretaceous Dakota Group and the Upper Jurassic Morrison Formation. Gas also is produced from the Frontier, Entrada, Shinarump, and Weber, of Late Cretaceous, Jurassic, Triassic, and Permian ages, respectively. Dakota and Morrison gas accumulations are controlled primarily by stratigraphic variations of the sandstone reservoirs. The total volume of gas sold in 1964 was 1,993 million cu ft and cumulative production was 33,789 million cu ft.—*from* Authors' abstract

Abbott, D. *See* Boorman, R. S. 07152

Achar, B. N. Narahari. *See* Brindley, G. W. 07148

01896 **Addie, George.** A new true thickness formula based on the apparent dip: Econ. Geology, v. 63, no. 2, p. 188, 1968.

True thickness = outcrop length in traverse direction X sin (apparent dip ± slope angle) × cos (true dip) divided by cos (apparent dip).—WSW

Agnew, Allen F. *See* White, Everett M. 01995

Aiello, Paul V. *See* Meighan, Clement W. 01925

01759 **Airhart, Tom Patterson.** The response of a pile-soil system in a cohesive soil as a function of the excess pore water pressure and the engineering properties of the soil [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4117B–4118B, 1968.

07293 **Akizuki, Mizuhiko.** Electron microscope observations of liquid inclusions in fluorite from some Mississippi Valley type deposits of America: Tohoku Univ. Sci. Repts., 3d ser., v. 10, no. 1, p. 49–54, illus., tables, 1967.

Liquid inclusions in fluorite from some Mississippi Valley type deposits of America have been observed under the electron microscope using the replica method. These habits have been compared with those of the liquid inclusions in fluorite from Japan and Korea. The variations in habit of these liquid inclusions have been determined to be due to the impurities within the liquid in the inclusions.—Authors' abstract

07151 **Alexiades, C. A.; Jackson, M. L.** Chlorite determination in clays of soils and mineral deposits: Am. Mineralogist, v. 52, nos. 11–12, p. 1855–1873, illus., tables, 1967.

A new thermal gravimetric method for the quantitative determination of chlorite in clays of soils and mineral deposits is described. The method is based on the OH water loss of K-saturated samples determined between 300 and 950°C. The

OH water loss due to other minerals such as mica and vermiculite is subtracted on the basis of system of analysis for each mineral.—*from* Authors' abstract

02127 **Alkire, James.** Willows–Beehive Bend gas field, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 639–642, illus., tables, 1968.

In Willows–Beehive Bend field, on an anticline near the center of the Sacramento Valley syncline, all gas is trapped on the east, or upthrown side, of a major northwest-trending fault which bisects the anticline. The southeast-plunging anticline contains many small pools which constitute a major gas field. Lenticularity of sandstone and faults control gas entrapment. The Cretaceous Kione Formation contains fairly continuous sandstone bodies and its gas reserves are in faulted structural traps. Gas in the Forbes and basal Kione is trapped primarily by sandstone lenticularity. A small amount of gas comes from the Dobbins Shale and the Guinda Formation below the Forbes.—HRC

07229 **Al-Rawi, Yehya; Carmichael, Ian S. E.** A note on the natural fusion of granite: Am. Mineralogist, v. 52, nos. 11–12, p. 1806–1814, illus., tables, 1967.

A small plug of basaltic–andesite has fused the granite into which it is intruded in a zone adjacent to the contact. The glass progressively decreases in amount away from the contact, and the analyses of two samples of this glass represent two points on a disequilibrium fusion curve. There is no evidence of metasomatism up to the stage where over half the granite has been fused.—Authors' abstract

07266 **Amsden, Thomas W.** Silurian and Devonian strata in Oklahoma, *in* Symposium—Silurian–Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 25–34, illus., 1967.

These strata crop out in the Arbuckle Mts. and Criner Hills of south-central and northeastern Oklahoma, and in the Ouachita Mountains of southeastern Oklahoma and western Arkansas. The Ouachita-area rocks, more poorly known, are discussed separately. Otherwise, the two systems are represented by two distinct lithofacies: an upper dark shale unit of Upper Devonian–Lower Mississippian age, and an underlying carbonate section ranging from Early Silurian to Early Devonian; no Middle Devonian rocks are known. The dark shales are called the Woodford almost everywhere in the subsurface, and Chattanooga Shale in outcrop. An unconformity separates the shale from underlying carbonates. Silurian and Lower Devonian carbonate strata form a thin sequence of discrete lithostratigraphic and biostratigraphic units separated by unconformities; combined thickness of the two is about 400 feet.—*from* Author's abstract

07280 **Amsden, Thomas W.; Rowland, T. L.** Résumé of Silurian and Devonian strata in the subsurface of Oklahoma, *in* Symposium—Silurian–Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 22–24, illus., 1967.

In eastern Oklahoma, Silurian and Devonian strata are distinctly different and can be identified in cores, whereas, in central Oklahoma, they are very similar lithologically but can be distinguished biostratigraphically. The base and top of the Silurian–Devonian carbonate lithosome (or Hunton Group) can generally be detected if it is overlain by the Woodford Shale or underlain by the Sylvan Shale. These strata have not been examined in the deep Anadarko Basin as yet; the Sylvan and Woodford Shales have not been recognized in the Oklahoma Panhandle, and many believe that the Hunton is absent. In southern Oklahoma, the Devonian Frisco Formation rests on Ordovician rocks. Elsewhere, these two systems are well known; a general summary of their distribution is given.—HRC

07213 **Amstutz, G. C.; Giger, H.** Geometrical properties of mineral intergrowths in rocks and ores [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 282–283, 1967.

07252 **Anderson, Donald D.** Gageby Creek gas field, Anadarko basin [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 286, 1967.

Anderson, Duwayne M. *See* Low, Philip F. 01848

Anderson, Warren. *See* Lichtler, W. F. 01872

01722 **Anderton, Peter Wightman.** Structural glaciology of a glacier confluence, Kaskawulsh Glacier, Yukon Territory, Canada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3747B, 1968.

01868 **Andrews, J. R.** The structural chronology in the Nigerdlikasik area, Frederikshaab district, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 45–48, illus., 1968.

At least five phases of deformation and associated migmatization have been traced by mapping fold closures in amphibolite horizons. The chronology established is: (1) production of gneissic structures, (2) isoclinal folding of kilometer amplitude, (3) tight folding with axial surface migmatization, (4) intrusion of a large dike, (5) NW–trending open folds of large amplitude, and (6) folds with NNE to ENE migmatized axial surfaces with variable dips. Two stratigraphic levels of amphibolite can be distinguished: that in which dunitic ultrabasic lenses are common, and that bordered by a thin layer of brown–weathering gneiss with ultrabasic lenses absent.—ESL

02169 **Andrews, J. T.** Postglacial rebound in Arctic Canada—Similarity and prediction of uplift curves: Canadian Jour. Earth Sci., v. 5, no. 1, p. 39–47, illus., tables, 1968.

Twenty–one uplift curves indicate a similar proportional response through time. The time:altitude relationship can thus be expressed as a percent of uplift within a time period; a graph of results is a smoothly decelerating curve. Uplift curves can be approximated by the formula: $U = A(1-i^t)/(1-i)$ where U is uplift, t is time with 0.0 years being the moment of site deglaciation, i is a constant for Arctic Canada equal to 0.677, and A varies with time and amount of recorded uplift. Uplift curves can be predicted on the basis of elevation of the marine limit and date of site deglaciation from tables and a figure. Comparisons between Arctic Canada, east Greenland, and Fennoscandia indicate that relaxation times for a comparable period, 10×10^3 yr are 2.5, 1.7, and 3.0×10^3 yr, respectively. Residual uplift, calculated for a sector of Hudson Bay is 100 m.—*from* Author's abstract

Anthony, J. W. *See* Williams, S. A. 07182

07214 **Appleyard, E. C.** Syn–orogenic nepheline rocks in eastern Ontario and northern Norway [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 283, 1967.

02098 **Arleth, Karl H.** Maine Prairie gas field, Solano County, California, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 79–84, illus., table, 1968.

The main gas–bearing rocks are on an anticline in Eocene rocks. The considerable stratigraphic variation in the rocks leads to formation of many traps also. The age of the anticline is difficult to determine, but it seems associated with the nearby Midland Fault which is thought to be lower Eocene in age. Part of the closure is provided by the material filling the Markley Gorge, an erosional feature of late Eocene age which is filled with impermeable sediments, forming a barrier. Gas was introduced into the trap at a later time. Gas comes also from the Cretaceous "Starkey" sandstone which is not intersected by the gorge.—HRC

01871 **Armstrong, Richard Lee.** The Cordilleran miogeosyncline in Nevada and Utah: Utah Geol. and Mineralcg. Survey Bull. 78, 58 p., illus., table, 1968.

An Eocambrian to Middle Cambrian clastic sequence unconformably overlies the Precambrian basement and contains a widespread tillite member. Intertonguing Middle and Upper Cambrian shale and carbonates grow more dolomitic toward the top, and Lower Ordovician through Middle Devonian dolomites change upward to limestone. During Mississippian, clastics were deposited in Nevada, followed by Pennsylvanian limestones. In the Oquirrh basin, Utah, 20,000 feet of alternating

limestone and quartzite accumulated in the Pennsylvanian, continuing into the Permian, intertonguing southeastward with continental red beds. Permian deposits in Nevada are limestone with some evaporite. Lower Triassic shale and limestone are succeeded by continental conglomerate and eolian sandstone. Eight isopach maps and three paleostratigraphic cross sections accompany the report.—ESL

01879 **Arteaga, F. E.; White, Natalie D.; Cooley, M. E.; Sutheimer, A. F.** Ground water in Paradise Valley, Maricopa County, Arizona: Arizona Land Dept. Water Resources Rept. 35, 76 p., illus., tables, 1968.

A large part of Paradise Valley is underlain by more than 1,500 feet of water-yielding alluvial deposits, divided informally into the lower, middle, and upper alluvium; in places the alluvial deposits overlie the red unit. In the southern valley, upper and lower alluvium, and red unit are more permeable and yield more water to wells than the middle alluvium, whereas in most of the northern and central areas, wells do not penetrate as great a thickness of the lower alluvium and are not as productive. For the most part, the quality of water is suitable for municipal, irrigation, and domestic uses; to the south, the amount of dissolved solids is greater than recommended for domestic use. Water-level declines from 1946–65 ranged from about 75 feet at the north edge to more than 225 feet near Scottsdale; declines in other areas have been less.—*from* Authors' abstract

01697 **Aubert de la Rüe, E.** Une enclave française subarctique—Saint-Pierre et Miquelon: Sci. Progrès—La Nature, no. 3395, p. 81–86, illus., 1968.

Bedrock geology and structure of extreme diversity, surficial geology and geomorphology including glacial features, and economic geology, also climate, vegetation, and fauna, are sketched briefly in a semipopular article on the three main islands, Saint-Pierre, Grand Miquelon, and Langlade, and several islets comprising the French territory south of Newfoundland.—VMJ

02166 **Aumento, F.** The Mid-Atlantic Ridge near 45° N.—Pt. 2, Basalts from the area of Confederation Peak: Canadian Jour. Earth Sci., v. 5, no. 1, p. 1–21, illus., tables, 1968.

Assisted by detailed bathymetric and bottom photographic coverage, a series of closely spaced samples of rock were taken by dredging along a traverse from the center of the Median Valley to the adjacent crest mountains on the Mid-Atlantic Ridge. The specimens show a gradation from tholeiitic to alkali basalts. Chemical variations, and the alkali content in particular, can be correlated with the depth of extrusion and with the topographic relationship of the volcanoes to the axis of the Median Valley. Although the basalts show considerable evidence of gravity-controlled crystal fractionation, the trends so established are evidently not responsible for alkali enrichment, but appear to be superimposed onto the more fundamental, continuous trend from tholeiitic to alkali basalts.—Author's abstract

01811 **Avrett, James R.** A compilation of ground water quality data in Alabama: Alabama Geol. Survey Circ. 37, 336 p., illus., tables, 1968.

This report is a compilation of all available data on the quality of ground water collected from numerous public and private organizations, and is believed to be the most complete presentation of such data in Alabama to date. Chemical and physical character of water and the significance of these properties, and water quality as related to domestic, industrial, irrigation, and recreational uses are discussed. Chemical analyses (total 3,692) are compiled in separate tables by county. Radioelement data for 14 sites are tabulated separately.—*from* Author's abstract

01890 **Axelrod, Daniel I.** Tertiary floras and topographic history of the Snake River basin, Idaho: Geol. Soc. America Bull., v. 79, no. 6, p. 713–733, illus., tables, 1968.

Paleobotanic data are interpreted to support the hypothesis of an Eocene north-south-trending topographic high across central Idaho, whose summit areas, over 4,000 feet in elevation, supported coniferous forests and whose flanks, deciduous and mixed deciduous-conifer forests. The data further suggest that the central part

of this high collapsed to produce a Miocene basin at the location of the present Snake River Plains. The origin of this basin is correlated with a postulated northward drifting of the Idaho batholith.—RGY

07289 **Axelrod, Daniel I.** Quaternary extinctions of large mammals: California Univ. Pubs. Geol. Sci., v. 74, 42 p., illus., 1967.

Tertiary climates of high equability enabled "tropical" and "temperate" biotas to intermingle throughout temperate latitudes; the mammal faunas adapted to the cooling trend. But in the Quaternary at least four major cold stages with progressively lowered equability caused widespread extinctions, chiefly of the "tropical" large grazing mammals. Though interglacial droughts did not cause much extinction, severe drought and cold after the last glaciation evidently were complementary in causing major extinction; highest extinction occurred in regions of lowest equability. The rich ungulate fauna of the African plateau escaped major extinctions because of equatorial location and high equability throughout the Quaternary. Small mammals escaped major extinctions, because of protected habitats (burrows, etc.) and seasonal and daily habits.—VMJ

01822 **Azároff, Leonid V.** Elements of X-ray crystallography: New York, McGraw-Hill Book Co., 610 p., illus., tables, 1968.

The book is designed to serve as a text in college courses on X-ray crystallography, and for self-study. Diffraction of X-rays is approached by the reciprocal-lattice concept. The material is divided into four parts: elements of crystals, of X-ray physics, of diffraction theory, and of experimental methods. There is a total of 20 chapters, and those requiring a more advanced knowledge of modern physics and mathematics are marked with an asterisk. Exercises and suggestions for supplementary reading conclude each chapter. Appendixes cover mathematical relations, physical constants, suggestions for a crystallographic library, and answers to selected problems.—ESL

01823 **Badash, Lawrence.** Rutherford, Boltwood, and the age of the earth—The origin of radioactive dating techniques: Am. Philos. Soc. Proc., v. 112, no. 3, p. 157-169, portraits, 1968.

William Thomson (Lord Kelvin) in 1862 concluded that, on the basis of physical phenomena, the Earth formed between 20 and 400 m.y. ago. Discovery of radioactivity and announcement of its heat production upset the assumption of a cooling globe. Rutherford and Soddy advanced the theory that radioactivity is transformation of one element into another. A lecture by Rutherford started Boltwood tracing genetic relationships of radioelements. In 1906, some helium ages were published, and in 1907, lead ages. The age of the Earth was calculated at 2,200 m.y., but geologists leaned toward Kelvin's estimate. The paper on lead ages was Boltwood's only contribution to dating, while Rutherford continued to publish. When Joly began to doubt the helium- and lead-methods, Holmes elaborated on Boltwood's work. Discovery of isotopes in 1913 made the methods more accurate.—ESL

Bailey, S. W. *See* Lister, Judith S. 07233

Baker, B. L. *See* Hodgson, G. W. 07285

Balashov, Yu. A. *See* Semenov, E. I. 07150

01851 **Baldar, N. A.; Whittig, L. D.** Occurrence and synthesis of soil zeolites: Soil Sci. Soc. America Proc., v. 32, no. 2, p. 235-238, illus., 1968.

Analcime has been identified by X-ray diffraction analysis in a number of strongly alkaline soils developed from granitic alluvium in the San Joaquin Valley, Calif. Its occurrence is restricted to soils containing Na_2CO_3 and with pH above 9; it is generally concentrated near the soil surface and is most abundant in fine silt and coarse clay fractions. Its occurrence and distribution support the conclusion that analcime is of pedogenic origin. Cation exchange data indicate that its Na is slowly replaced by NH_4, and relatively little by the divalent cations Ca and Ba.

Analcime was effectively destroyed in a soil by treatment with 0.5 *N* HCl; it was readily synthesized in the acid-treated soil and in the acid extract from the soil by titration of the systems to pH 9 and above.—*from* Authors' abstract

01691 **Balster, Clifford A.; Parsons, Roger B.** Sediment transportation on steep terrain, Oregon Coast Range: Northwest Sci., v. 42, no. 2, p. 62–70, illus., 1968.

Particle-size data were obtained for materials on steep slopes of two gulches entering Woods Creek Canyon in the central part of the foothills near the edge of Willamette Valley. The Eocene Siletz River formation underlies the drainages, and depth of weathering on these basalts varies greatly. The gulches are floored by coarse basalt cobbles near the heads, and particle-size decreases rapidly downstream. Fans are poorly sorted and may result from earthflow; the radiocarbon date from the base of a fan indicates no net downcutting during the last 9570±510 yr. The creek is considered at grade, carrying away material as it is made available by mass movement and fluvial processes. Material on valley slopes becomes finer downslope due to sheet flood and rill erosion, and weathering of fragments; gentler slopes are more stable.—ESL

Bamberg, Samuel A. *See* Major, Jack. 02089

01723 **Banks, Norman Guy.** Geology and geochemistry of the Leadville Limestone (Mississippian, Colorado) and its diagenetic, supergene, hydrothermal and metamorphic derivatives [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3747B–3748B, 1968.

07215 **Baragar, W. R. A.** Geochemistry of Noranda, Quebec, volcanic rocks [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 283–284, 1967.

Barber, Thomas D. *See* Halbouty, Michel T. 02120

02177 **Bardack, David.** Fossil vertebrates from the marine Cretaceous of Manitoba: Canadian Jour. Earth Sci., v. 5, no. 1, p. 145–153, illus., tables, 1968.

The vertebrate fauna from the Upper Cretaceous of Manitoba is described. Of the 18 genera, 13 have not been recorded previously from this province. The vertebrate assemblage resembles that of the Niobrara Formation of western Kansas, but is noteworthy for the relative abundance of toothed birds.—Author's abstract

Barger, Ralph M. *See* Burroughs, Ernest. 02100

07216 **Barker, D. S.** Texture, composition, and origin of graphic granite [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 284, 1967.

02107 **Barnds, Ray M.** Playa del Rey oil field, Los Angeles County, California, natural gas storage, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 169–173, illus., table, 1968.

The abandoned Playa del Rey oil field is being used as a gas storage reservoir. The Miocene rocks were deposited on the flanks of and over the ridge of an erosional surface of Jurassic Franciscan Schist; a northwest-trending anticline resulted. An apron of schistose clastic material was deposited in the littoral zone at the base of the ridge and local embayments; over this is a thin shale formation. The rest of the Miocene is hard shale and sandstone overlain by typical Los Angeles basin Pliocene and Pleistocene rocks. The Playa del Rey field is in the lower Miocene rocks in the anticline and from the schist. The gas will be injected into the basal conglomerate which is overlain by shale.—*from* Author's abstract

02181 **Barnes, Christopher R.** Reply [to discussion by M. Kay, 1968, of] "Stratigraphy and sedimentary environments of some Wilderness (Ordovician) limestones, Ottawa Valley, Ontario" by C. R. Barnes [1967]: Canadian Jour. Earth Sci., v. 5, no. 1, p. 169–172, 1968.

Barnes discusses a few problems stemming from Kay's comments (ibid., p. 166–169) on Middle Ordovican stratigraphic nomenclature—the use of 'formations' for litho-, bio-, and chronostratigraphic terms. The second section deals with stratigraphy at Rockland and Pakenham, based in part on fossils.—ESL

Barnes, H. L. *See* Scott, S. D. 07175

Barnes, Peter W. *See* Gorsline, Donn S. 01904

07259 **Barnes, Virgil E.** Frank Alfred Herald (1887–1965): Tulsa Geol. Soc. Digest, v. 35, p. 293–295, 1967.

01991 **Bartlett, Grant A.** Planktonic Foraminifera—New dimensions with the Scanning Electron Microscope: Canadian Jour. Earth Sci., v. 5, no. 2, p. 231–233, illus., 1968.

Extremely fine, detailed morphological characteristics of micro-organisms, hitherto unavailable, can now be determined with the Scanning Electron Microscope. Morphological characteristics related to evolutionary sequences, specific, generic, and familial relationships will permit more natural faunal classifications and enable more accurate ecological and biostratigraphic correlations.—Author's abstract

02087 **Bartlett, Grant A.** Planktonic Foraminifera—A history of oceans [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 519–520, 1968.

02007 **Bassarab, Dennis R.; Huff, Warren D.** Clay mineralogy of Kope and Fairview Formations (Cincinnatian) in Cincinnati area [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 520, 1968.

01698 **Bayley, Richard W.; Muehlberger, William R.** (compilers). Basement rock map of the United States, exclusive of Alaska and Hawaii: Washington, D.C., U.S. Geol. Survey, 2 sheets, scale 1:2,500,000, 1968.

An index map shows principal basement map provinces: Precambrian craton, Wichita–Arbuckle Mountain belt, Appalachian crystalline rocks, Nevada crystalline rocks, and Franciscan facies basement. Sources and contributors of surface geology are listed.—MCM

02110 **Beebe, B. W.** Occurrence of natural gas in Mexico, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 209–232, illus., tables, 1968.

Only two areas in Mexico are important gas producers—the Burgos basin, a southward extension of the Rio Grande Embayment; and the Isthmus–Tabasco region in southeastern Mexico. Most of the gas in the Burgos basin is nonassociated and comes from closed structures in Miocene, Oligocene, and Eocene sandstones. Recently-obtained Cretaceous production is as yet unevaluated. The José Colomo field in the Tabasco area produces mostly nonassociated gas, although some dissolved and associated gas occurs in the Isthmus Saline basin toward the west. Many of the gas structures in this region are on salt diapirs.—HRC

02151 **Beebe, B. W.** Natural gas in Denver basin, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 899–927, illus., tables, 1968.

The largest gas deposit is dissolved and associated gas in the Adena oil field. Much of the other gas is dissolved in oil. Large areas in the basin have not had the Cretaceous rocks explored definitively. The eastern edge of the basin is believed to have good potential for discovery of nonassociated gas in the Lower Cretaceous. The Upper Cretaceous Hygiene Sandstone Member of the Pierre Shale may have potential for gas discovery. The Paleozoic strata, unrelated to the basin structurally, are intriguing and promising as gas reservoirs as Paleozoic carbonate rocks at the edges of the basin contain gas and oil.—*from* Author's abstract

02154 **Beebe, B. W.** Deep Edwards trend of South Texas, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 961–975, illus., tables, 1968.

Edwards Limestone production is found in both reef and back-reef facies of coquina-like fossiliferous limestone and dolomitized limestone. Porosity and permeability are markedly varied. Part of the accumulation in the northeastern part of the productive area is controlled structurally by closures against up-to-the-coast faults along the Charlotte-Sample and the deep Edwards fault trends. Southward and southwestward, along the Stuart City reef trend, accumulation is controlled primarily by reefs. Three fields appear to produce from traps resulting from local deep-seated salt domes. Possibilities for additional deep Edwards and pre-Edwards Cretaceous and Jurassic discoveries appear to be good.—*from* Author's abstract

02165 **Beebe, B. W.** Natural gas in post-Paleozoic rocks of Mississippi, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 1176–1226, illus., tables, 1968.

Gas originally was produced from the Jackson field in the Selma Formation, but is now produced from the Tertiary Wilcox, Cockfield, and Sparta Formations, and from the Cretaceous and Jurassic rocks, the Upper Cretaceous Eutaw and Tuscaloosa Sandstones being the most important. Most gas accumulations are structurally controlled with a few stratigraphic-structural traps. Most of the structures are related to salt movement, although shallow salt diapirs have not afforded significant production of oil or gas. The future rests on finding more stratigraphic traps as well as additional structures. Deeper drilling will also be required. Most of the Upper Jurassic gas, particularly from the Smackover, contains considerable hydrogen sulfide and inert gases.—HRC

02093 **Beebe, B. Warren; Curtis, Bruce F.** (editors). Natural gases of North America, a symposium in two volumes—Pt. 1, Natural gases in rocks of Cenozoic age; Pt.2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, 1226 p., illus., tables, 1968.

Papers in the symposium are divided on a geological time basis (Cenozoic, Mesozoic, and Paleozoic) and reflect geological rather than geographical assemblages. Emphasis is on presentation of chemical analyses of gases from the various areas, and on illustration of the wide compositional variations among natural gases. Relating natural gas types with original depositional environments, and with configurations of basins and various sorts and depths of traps, offers a challenging field for research in effective and economical exploration for natural gas.—*from* Editors' foreword

Beecroft, George W. *See* Burroughs, Ernest. 02100

07217 **Beger, R. M.; Buerger, M. J.** The structure of pollucite [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 284–285, 1967.

01873 **Beiser, Arthur; Time-Life Books Editors.** The earth: New York, Time-Life Books (Life Nature Library), 192 p., illus., revised 1968; originally published 1962.

This book is not a scientific treatise, but with its fine photographic illustrations is an introduction to the Earth and its processes for the nonprofessional reader. Included in its chapters are the place of this planet in the universe, its origin, emergence of the crust, shaping of the landscape, record of the rocks, and question of its destiny. The introduction to the book is written by William W. Rubey, Emeritus Professor of Geology and Geophysics, University of California, Los Angeles.—GDC

07188 **Bender, James A.** Deformation of excavations in high polar névé, *in* Physics of snow and ice—Internat. Conf. on Low Temperature Science, Sapporo, Japan, 1966, Proc., V. 1, Pt. 2: Sapporo, Japan, Hokkaido University, p. 973–982, illus., tables, 1967.

Excavations have been made in a high polar névé as part of a long-range study toward the development of a rational snow mechanics. Ten years of observed data on the deformation and computed overburden are presented for a shallow horizontal tunnel in snow, and eight years of data are given for a horizontal tunnel at great depth. Data on other excavations in snow are predicted for a depth of about 40 m based upon increase of both overburden pressure and viscosity with depth. Author's abstract

Bennett, G. D. *See* Perlmutter, N. M. 01818

Bennett, Jarratt G. *See* Passwater, Richard A. 07292

01724 **Berg, Orville Roger.** Quantitative study of the Cherokee-Marmaton Groups, west flank of the Nemaha Ridge, north-central Oklahoma [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3748B, 1968.

01812 **Berger, Wolfgang H.; Heath, G. Ross.** Vertical mixing in pelagic sediments: Jour. Marine Research, v. 26, no. 2, p. 134–143, illus., table, 1968.

Vertical mixing in sediments can be quantitatively described if it is assumed that: (1) upon deposition, detrital particles are mixed uniformly to a depth below the sediment-water interface at a much faster rate than sedimentation rate; (2) the species, whose vertical distribution is to be described, appears or disappears abruptly; and (3) the species, throughout its time-range, forms a constant proportion of the sediment. Upon appearance, concentration of the species increases rapidly from a first occurrence of m units below the contemporaneous ocean floor. Upon extinction, concentration decreases gradually, with significant upward contamination extending about six mixed-layer thicknesses above the extinction level. Marked stratigraphic errors can appear if layers representing time ranges are similar in thickness to the mixed layer, as may be the case in many Quaternary sediments.—*from* Authors' abstract

01763 **Berkey, Edgar.** Terrestrial modification of trace elements in iron meteorites [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3632B, 1968.

01955 **Berner, Robert A.** Rate of concretion growth: Geochim. et Cosmochim. Acta, v. 32, no. 5, p. 477–483, illus., 1968.

Mathematical expressions for the time of growth of spherical post-depositional concretions from flowing and nonflowing supersaturated ground water are derived based on ionic diffusion as the rate-controlling growth mechanism. The theoretical treatment is that used by Frank (1950) and Nielsen (1961) for physically analogous problems. Application of the equations to the growth of $CaCO_3$ concretions is done in the form of growth curves for different ground water flow rates. For a typical slowly flowing ground water supersaturated in $CaCO_3$ by 10 ppm the time of growth of calcite concretions ranges from about 500 yr for concretions of 1 cm radius to about 12,000 yr for those of 5 cm radius.—Author's abstract

02051 **Bernier, B.; Carrier, J.-L.** Étude sur l'extraction du fer et de l'aluminium libres dans les sols podzolisés [with English abs.]: Naturaliste Canadien, v. 95, no. 2, p. 247–257, illus., tables, 1968.

A comparative study was made of effectiveness of various reagents in extracting free iron and aluminum from strongly podzolized soils; determination of these elements is indispensable for genetic characterization of soils. All methods yielded similar results in the upper B horizon, but in the lower solum and C horizons ammonium oxalate at 100°C or at boiling point, hydrosulfite-tartrate, and hydrosulfite-EDTA all yielded appreciably more iron than did acid ammonium oxalate 0.2M, indicating an attack on crystalline iron oxides (in biotite, hematite, hornblende, ilmenite, olivine). The latter method, when used in darkness and at room temperature, was the best indicator of accumulation of amorphous compounds of iron and aluminum derived from recent weathering.—VMJ

Bertine, K. K. *See* Kharkar, D. P. 01956

01797 **Bhatnagar, V. M.** Infrared spectra of mineral apatites: Soc. Française Minéralogie et Cristallographie Bull., v. 91, no. 1, p. 90–91, tables, 1968.

Specimens studied were from Wilberforce, Ontario; Cerro Mercado, Durango, Mexico; Odegaard, Norway; and two from the Kola Peninsula, U.S.S.R. The chemical analyses are presented and frequencies tabulated. Several poorly crystallized apatites had a water absorption band but a hydroxyl band was absent or very weak due to the high fluorine content. Assignments of important frequencies are given.—ESL

Bideaux, Richard A. *See* Pemberton, H. Earl. 02085

Bidwell, L. E. *See* Cotter, R. D. 02075

07241 **Biederman, E. W., Jr.** Petroleum geochemistry [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 277, 1967.

02026 **Bird, Kenneth John.** Biostratigraphy of the Tyee Formation (Eocene), southwest Oregon [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4619B, 1968.

01857 **Birkelund, Tove.** The Permian and Triassic of the Cape Stosch area, East Greenland, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 78–82, 1968.

The lower part of the Triassic consists of near-shore deposits, and some horizons are rich in ammonite and fish faunas; the upper part consists of sandstones and variegated shales. Except for a few beds with pelecypods and gastropods, and a horizon containing stegocephalians, it is unfossiliferous. There are seven prominent conglomerate horizons in the western part, which grade into sandstone to the east. The Permian–Triassic boundary is concealed by solifluction in most places, but six sections were measured and samples collected for microfossils. Collections were also made of ammonites and fish from the Triassic and of Permian fish and belemnoids.—ESL

01705 **Birle, John David.** An investigation of the high pressure, subsolidus phase equilibrium relations in the system Al_2O_3–GeO_2 as a model for the ultra high pressure behavior of kyanite [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3808B, 1968.

07317 **Bissada, K. K.; Johns, W. D.; Cheng, F. S.** Cation–dipole interactions in clay organic complexes: Clay Minerals, v. 7, no. 2, p. 155–166, illus., tables, 1967.

Quantitative gas chromatography supplemented by X-ray diffraction studies of adsorption of ethanol and acetone on homoionic montmorillonite showed marked variation in number of molecules associated with each exchange cation. K^+ and Na^+ associate with two and three molecules, respectively, of ethanol or acetone, and resulting complexes expand to form a monolayer. Dependence of ethanol and acetone adsorption on the nature of the exchangeable cation suggests that cation–dipole interactions are important in the adsorption process. Structural models of the complexes are given.—ESL

02021 **Black, Thomas John.** A test apparatus for frozen soil in complex stress [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4565B–4566B, 1968.

07290 **Blackadar, R. G.** Precambrian geology of Boothia Peninsula, Somerset Island, and Prince of Wales Island, District of Franklin [with French abs.]: Canada Geol. Survey Bull. 151, 62 p., illus., tables, geol. maps, 1967.

Boothia Peninsula and western Somerset Island are dominated by the Boothia Arch, a structural and topographic high composed of Precambrian igneous and metamorphic rocks. Relatively flat-lying unfossiliferous sedimentary strata overlie the northernmost exposures of Boothia Arch, and they are in turn overlain by lower Palaeozoic sedimentary rocks. All pre-Palaeozoic rocks are cut by gabbro dikes and sills. These are most abundant in western Somerset Island. Potassium–argon age determinations made on biotite indicate an Aphebian (early Proterozoic) age

for the latest metamorphism of the gneissic complex. The results of modal analyses and 82 "rapid method" chemical analyses accompany the descriptions of the gneissic and igneous rocks. [Geologic maps 1219A and 1220A are in pocket.]—Author's abstract

07320 **Blackadar, R. G.** Geological reconnaissance, southern Baffin Island, District of Franklin: Canada Geol. Survey Paper 66-47, 32 p., illus., geol. maps, 1967.

Operation Amadjuak, a helicopter-supported project, completed the geological reconnaissance of that part of Baffin Island that lies south of latitude 66° N. and southwest of Cumberland Sound, an area of about 50,000 square miles. Southern Baffin Island is composed primarily of a wide variety of metamorphic rocks, which on the basis of the few currently available isotopic age determinations, are all part of the Churchill Structural Province. Paleozoic carbonate and argillaceous carbonate rocks outcrop to the south and northwest of Amadjuak Lake. Several small outliers including Silliman's Fossil Mount occur between the main outcrop area and Frobisher Bay. A Middle Ordovician age has tentatively been assigned to the Paleozoic rocks.—Author's abstract

02175 **Boissonneau, A. N.** Glacial history of northeastern Ontario—[Pt.] 2, The Timiskaming-Algoma area: Canadian Jour. Earth Sci., v. 5, no. 1, p. 97-109, illus., 1968.

The surficial deposits, ice movements, and glacial lakes within an area of 34,500 sq mi in northeastern Ontario are described. Some of the moraines of the study are tentatively correlated with moraines to the west in the upper peninsula of Michigan, in the Nipigon area, and along the north shore of Lake Superior. The glaciolacustrine deposits and sequence of events in the study area in relation to the glacial features and chronology of the southern Great Lakes basin provide a basis for a partial glacial chronology for the study area. A knowledge of the glacial features of this area further elucidates the integration of movements of two advancing ice lobes, which was observed in northwestern Quebec.—Author's abstract

Bonatti, Enrico. *See* Fisher, David E. 01926

02065 **Bondesen, E.** Research on the high-metamorphic complexes of the Agto area, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 19-21, 1968.

The Isortoq granulite facies complex in the south and the amphibolite facies gneisses of the Egedesminde complex in the north have contrasted tectonic development as well as metamorphic history. Three main structural areas have been established: an upper unit consisting of metasediments, occurring synformally; a lower unit of banded amphibolites, complexly folded; and another lower unit, mainly agmatites. All three are controlled by ENE-trending axes, refolded by NW-trending steeply plunging fold axes. A major thrust zone runs along Gieseckes Sö. A variety of granitic rocks occurs in the west, and four main types of metadikes have been discovered.—ESL

07152 **Boorman, R. S.; Abbott, D.** Indium in co-existing minerals from the Mount Pleasant tin deposit: Canadian Mineralogist, v. 9, pt. 2, p. 166-179, illus., tables, 1967.

Arsenopyrite, pyrite, galena, cassiterite and molybdenite concentrates from Mount Pleasant each contained less than 0.05 weight percent indium whereas three chalcopyrite concentrates contained 0.98, 0.38, and 0.16 weight percent. Microprobe analysis indicated that the principal carriers are tetragonal stannite, sphalerite, chalcopyrite, and digenite, with 2.1, 1.25, 0.19, and 0.11 weight percent indium, respectively. The substitution mechanism of indium in these minerals is discussed. X-ray data and chemical analyses for tetragonal stannite from Mount Pleasant deposit is given and compared with data from the literature.—JLH

Bormann, F. H. *See* Johnson, Noye M. 01984

Bottino, Michael L. *See* Fullagar, Paul D. 01972

07271 **Boucot, A. J.; Johnson, J. G.** Paleogeography and correlation of Appalachian Province Lower Devonian sedimentary rocks, *in* Symposium—Silurian–Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 35–87, illus., tables, 1967.

Correlations of Lower Devonian strata in the Appalachians are based almost entirely upon brachiopod faunas. Four zones, based primarily upon rensselaeriid evolution, are delineated. Manlius–Coeymans equivalents are not widespread beyond the New York–Pennsylvania region. Above these, in the middle and upper part of the Helderbergian, the brachiopod-rich rocks are widespread. Oriskany equivalents are widespread and often rest upon an unconformity. Above these, in Esopus time, the sedimentation was restricted. Next, during Schoharie time, the rocks are again widespread. Correlations with northern Europe are described also. Several animal communities, based largely upon brachiopods, are recognized. The faunal zones do not conform to the lithological zones, however.—HRC

Bourns, G. E. *See* Jackson, K. E. 02135

Bowles, R. C. *See* Stehr, Raymond A. 07257

07267 **Bowsher, Arthur L.** The Devonian system of New Mexico, *in* Symposium—Silurian–Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 259–276, illus., 1967.

Devonian rocks, absent in most of central New Mexico, average 85–90 feet in the south-central area, and up to 500 feet thick in the southwest. Late-Middle Devonian rocks are the Canutillo and Onate Formations. The overlying Sly Gap and Contradero Formations contain Chemung-aged faunules. The uppermost Thorogood, Rhodes Canyon, and Ready Pay Member of the Percha Shale contain Cassadaga-Stage faunules. The Box Member of the Percha contains a late Devonian Conewago faunule. Facies changes are described, and mild epeirogenic structures are reflected by the facies changes. The faunal evidence supports partial correlation of the New Mexico Devonian with the Caballos Novaculite of the Trans-Pecos area, the Woodford Shale of west Texas and Oklahoma, and the Arkansas Novaculite of Oklahoma and Arkansas.—HRC

02055 **Boyle, R. W.; Shafiqullah, M.; Durham, C. C.; Tupper, W. M.; Friedrich, G.; Ziauddin, M.; Carter, M.; Bygrave, K.** Minor and trace element distribution in the heavy minerals of the rivers and streams of the Bathurst–Jacquet River district, New Brunswick: Canada Geol. Survey Paper 67–45, 9 p., illus., 1968.

This report describes the elemental distribution in heavy minerals collected from stream sediments in the Bathurst–Jacquet River district of New Brunswick. In a general way the variations of the elemental content of the heavy minerals reflects underlying bedrock and it appears that heavy mineral sampling in detail would be a useful way to conduct a reconnaissance geochemical survey for mineral deposits in the area.—Authors' abstract

01725 **Bradbury, John Platt.** Origin, paleolimnology, and limnology of Zuni Salt Lake maar, west-central New Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3748B–3749B, 1968.

Bradley, W. F. *See* Susa, K. 07318

01909 **Brecke, E. A.** Copper mineralization in the upper part of the Copper Harbor Conglomerate at White Pine, Michigan [discussion of paper by S. K. Hamilton, 1967]: Econ. Geology, v. 63, no. 3, p. 294, 1968.

Reduction of iron by hydrothermal alteration adjacent to fluorspar deposits suggests a similar origin for the phenomenon at White Pine. (For original paper, *see* ibid., v. 62, no. 7, p. 885–904, 1967.)—WSW

02046 **Breiner, Sheldon.** The piezomagnetic effect in seismically active areas [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4630B–4631B, 1968.

Brent, Millard D. *See* Lokke, Donald H. 02163

Bright, R. C. *See* Watts, W. A. 01999

07148 **Brindley, G. W.; Achar, B. N. Narahari; Sharp, J. H.** Kinetics and mechanism of dehydroxylation processes—[Pt.] 2, Temperature and vapor pressure dependence of dehydroxylation of serpentine: Am. Mineralogist, v. 52, nos. 11–12, p. 1697–1705, illus., tables, 1967.

Measurements of the dehydroxylation of a serpentine from Cardiff, Maryland, at 630–770°C and water vapor pressures of <0.001 to 47 mm Hg are consistent with a diffusion controlled reaction mechanism. The apparent activation energy of the reaction ranges from 68 kcals per mole at <0.001 mm Hg to 120 kcals per mole at 47 mm Hg. The vapor pressure dependence of the reaction at constant temperature is interpreted in terms of fractional coverage of the reacting surface by a layer of chemisorbed water. The fractional coverage ranges from near zero at 0.001 mm Hg and 630–700°C to 95 percent at 47 mm Hg and 636°C.—*from* Authors' abstract

07218 **Bristol, C. C.** The quantitative X-ray powder diffraction determination of minerals in some metamorphosed volcanic rocks [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 285, 1967.

01992 **Bristol, Calvert C.** The quantitative determination of minerals in some metamorphosed volcanic rocks by X-ray powder diffraction: Canadian Jour. Earth Sci., v. 5, no. 2, p. 235–242, illus., tables, 1968.

A method is described for the quantitative X-ray powder diffraction determination of minerals in metamorphosed volcanic rocks of the greenschist, epidote-amphibolite, and amphibolite facies. In this method the intensity of the (111) diffraction for a powdered metallic Cu internal standard was compared to the intensities of selected diffractions for minerals of each facies. Graphs relating X-ray diffraction intensities to concentrations were prepared for actinolite, albite, almandine, anthophyllite, biotite, chlorite (omega: 1.59), diopside, epidote, hornblende, muscovite ($2M_1$), plagioclase (An_{30}), and quartz. Results using this method are within ±2 1/2–5 wt percent of those obtained by Rosiwal analysis.—Author's abstract

02157 **Brogdon, D. R.** Opelika field, Henderson County, Texas, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 1005–1007, illus., table, 1968.

The Opelika field, in northeastern Henderson County, was discovered in 1937. The principal producing formation is the Rodessa (Lower Cretaceous). The accumulation is trapped in a faulted domal anticline; there is minor stratigraphic trapping. Gas-recycling operations were begun in 1941.—Author's abstract

Brooker, E. W. *See* Scott, J. S. 02057

07149 **Brown, C. Ervin.** Fluorite in crystal-lined vugs in the Maquoketa Shale at Volga, Clayton County, Iowa: Am. Mineralogist, v. 52, nos. 11–12, p. 1735–1750, illus., tables, 1967.

Vugs lined with calcite, color-zoned fluorite, sphalerite, and pyrite are described. The association calcite-pyrite-sphalerite, and their paragenesis, crystal habits, minor element content, and fluid inclusions suggest a genetic relation to the ores of the upper Mississippi Valley zinc-lead district. Occurrence of fluorite is anomalous however. Rare earth elements, present in the phosphatic wall rock, are not found in the fluorite suggesting that the crystals did not result from reorganization of chemical elements freed by a breakdown of the surrounding carbonate-fluorapatite.—*from* Author's abstract

Brown, J. *See* Tedrow, J. C. F. 02091

02105 **Brown, James B.** Gas in Los Angeles basin, California, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 149–163, illus., table, 1968.

Oil comes from upper Miocene and lower Pliocene clastic rocks in more than 50 fields in the Los Angeles basin. Gas is produced with the oil, but gas–oil ratios and market demands determine its production. Strata in the basin range from pre-Cretaceous to Recent in age, and are mainly clastic sedimentary and Miocene volcanic rocks. Three different stages of deformation have produced large closed, complexly faulted structures. The predominant trend in the basin is northwest-southeast; in many instances topographic expression reflects basement relief. Oil fields are developed on knolls and along the margins of the basin. The Wilmington field, the area's largest, is illustrative of the complexity in the basin.—*from* Author's abstract

01714 **Broyles, Bettye J.** St. Albans archaic site, West Virginia: West Virginia Geol. Survey Newsletter, 11th issue, p. 11, illus., 1968.

The St. Albans archaic site is located about 15 miles west of Charleston, on the Kanawha River. Cores have been taken to a depth of 29 to 37 feet; excavation to a depth of 18 feet showed 41 zones, 18 of which contained artifacts or hearths. Two new types of points were found. Radiocarbon dates of the sites range from 7900 to 6210 B.C.—ESL

Budd, Ronald C. M. *See* Clark, L. M. 02133

Buerger, M. J. *See* Beger, R. M. 07217

01789 **Buffam, B. S. W.** Moneta Porcupine Mines Limited, *in* Geology and ore deposits of Tisdale township: Ontario Dept. Mines Geol. Rept. 58, p. 134–138, table, reprinted 1968; originally published 1948.

The Moneta mine, operated from January 1938 to June 1943, produced 149,340 oz of gold and 22,045 oz of silver. Formations north of the Hollinger fault are a succession of andesitic lavas interbedded with carbonaceous shale, tuff, and agglomerate, overturned to the west. The part between the fault and the Krist fragmental is underlain by the upper members of the same series which are strongly folded and dip east. The south two-fifths is underlain by Krist fragmental. Ore occurs near contacts between a pillowed amygdaloidal andesite, a leucoxene andesite, and a wedge of medium-grained andesite with pillowed edges; carbonaceous shale lies along contacts of the wedge. Deposition was controlled by fractures, and ore consists of heavy sulfide replacement of brecciated pillow andesite. The orebody terminates below the 525-ft level.—ESL

Bukin, V. I. *See* Semenov, E. I. 07150

Buol, S. W. *See* Smith, B. R. 01839

01875 **Burk, C. A.** Buried ridges within continental margins: New York Acad. Sci. Trans., ser. 2, v. 30, no. 3, p. 397–409, illus., 1968.

This report points out examples of ridges buried at various depths beneath or near the edge of continental shelves along Atlantic North and South America, the Red Sea, western Africa, and Pacific North America. It may be that some of the continental margins not showing a ridge may represent stages preceding or long following its formation. Types of marginal ridges and possible origins are: block, rotational, or reverse faults; compressional folds; arching or uplift; differential subsidence; reef growth; volcanic chain or arc; and plutonic intrusion. Many appear to be in part the result of movement along normal faults with arching and reef growth contributing. A better understanding of these areas is needed and rock samples must be taken; also it is important to learn whether any fossil continental margins are exposed on land.—ESL

Burlingame, A. L. *See* Huag, Pat. 01957

02100 **Burroughs, Ernest; Beecroft, George W.; Barger, Ralph M.** Rio Vista gas field, Solano, Sacramento, and Contra Costa Counties, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 93–101, illus., tables, 1968.

Rio Vista gas field is in the Sacramento River delta about 30 mi southwest of Sacramento. The field was discovered by use of reflection-seismograph methods in 1936 and is the largest natural gas field in California in area, production, and reserves. There now are 182 potential wells on 22,560 proved acres. The structure of the field is a broad, flat, somewhat elongate faulted dome, with the axis striking north-northwest. Gas is produced from six zones of Eocene and Paleocene age at depths from 3,700 to 5,300 ft. Total gas production through December 31, 1965, was 2,316,901,122 Mcf. The highest annual production was 159,577,428 Mcf of gas in 1945.—Authors' abstract

Bygrave, K. *See* Boyle, R. W. 02055

07219 **Cabri, L. J.** A new copper-iron sulfide [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 285–286, 1967.

01774 **Calder, John A.; Parker, Patrick L.** Stable carbon isotope ratios as indices of petrochemical pollution of aquatic systems: Environmental Sci. and Technology, v. 2, no. 7, p. 535–539, illus., tables, 1968.

C-13:C-12 ratios of dissolved and particulate organic matter were measured from several natural aquatic systems and from systems polluted by organic chemicals. δC-13 from natural systems ranges from –14 to –23 relative to the Natl. Bur. Standards isotope reference material no. 20; petroleum and petrochemical products are much more depleted in C-13, ranging from –25 to –49. Three areas were sampled in detail: the Houston and Corpus Christi, Tex., ship channels and a Texas petrochemical plant adjacent to a marine bay. Model calculations based on δC-13 of dissolved organic matter measured for 15 samples from the Houston ship channel suggest that the C-13:C12 ratio of DOM may serve as a quantitative index of petrochemical pollution.—VMJ

07265 **California Dept. Water Resources.** Earthquake damage to hydraulic structures in California: California Dept. Water Resources Bull. 116-3, 200 p., illus., tables, 1967.

This document describes damage to hydraulic structures in California and adjacent areas by earthquakes that occurred within the past century. Unconsolidated alluvium, generally saturated and thick, was the predominant material underlying the damaged structures; filled ground underlay many in the San Francisco Bay area. Such soft foundations are especially correlated with damage that occurred many miles from earthquake sources. Canals, ditches and dams sustained slumping, fissuring, sloughing, and offset; pipes were ruptured, telescoped, pulled apart and bent; storage tanks toppled. Eighty-two earthquakes are identified as responsible for the damage. Comprising damage recorded here are 53 storage structures, 22 dams, 35 major water conduits, 101 water mains and pipes, 5 pumping and power stations, 13 irrigation facilities, 40 petroleum product structures, 9 sewerage structures, and 1 dike.—*from* Author's abstract

07283 **California Dept. Water Resources.** Ground water occurrence and quality, San Diego Region—V. 1, Text; V. 2, Plates: California Dept. Water Resources Bull. 106-2, 235 p., illus., tables, geol. map, 1967.

Geohydrochemical evaluation of 11 hydrologic units within this drainage province included lithologic correlation; ground waters in each were classified as to suitability for domestic and irrigation uses. Increased pumping has led to sea-water intrusion and migration of connates into ground-water reservoirs. Chemical effects of man's activities are far-reaching where there has been drought and little recharge. Supplemental waters have also modified the chemical quality of native ground water. Inland, waters associated with continental Pleistocene sediments and with crystalline

rocks are sodium to calcium bicarbonate in character; dissolved solids are less than 600 ppm. Waters associated with more basic rocks, such as gabbros, are magnesium rich. In coastal areas, waters in pre-Quaternary sediments have a dissolved-solids content of 400 to 2,000 ppm; sodium and chloride ions predominate.—GDC

01961 **Cameron, E. M.** A geochemical profile of the Swan Hills Reef: Canadian Jour. Earth Sci., v. 5, no. 2, p. 287–309, illus., tables, 1968.

Over 400 samples were taken from cores that form a vertical plane section through Swan Hills Reef, an oil-bearing reservoir in Devonian rocks of west-central Alberta. Quantitative determinations for eight elements were made on the samples by direct-reading emission spectrometry. Resulting chemical data show that dolomite appears to be derived mainly from high-Mg calcite of possible algal origin that was formed on the windward side of the reef. Sr held in calcite as a solid solution impurity shows a primary trend to depletion in the organic framework facies marginal to the reef, as a result of greater diagenetic leaching of these rocks. Secondary variation of Sr may show periods of reef elevation and subaerial weathering. Vertical variation of Mn and Fe in solid solution in calcite appears to be related to regional tectonic changes.—MST

01719 **Campbell, F. A.; Oliver, T. A.** Mineralogic and chemical composition of Ireton and Duvernay Formations, central Alberta: Bull. Canadian Petroleum Geology, v. 16, no. 1, p. 40–63, illus., tables, 1968.

Samples from four cored wells in central Alberta were studied by X-ray fluorescence and diffraction methods in order to determine the chemical composition and mineralogy of the Upper Devonian Ireton and Duvernay Formations. The results are presented as both chemical and mineralogic logs of the cores. The dominant minerals throughout are illite, chlorite, quartz, dolomite and calcite. Vertical variations are extreme, with rocks ranging from pure carbonate to those with about 25 percent carbonate and the remainder consisting of the silicates. Individual stratigraphic units show no significant lateral variations across the basin. Both local and regional implications of the data are discussed.—Authors' abstract

07270 **Campbell, K. S. W.** Geographic and stratigraphic implications of a study of the Henryhouse trilobite fauna, *in* Symposium—Silurian-Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 253–258, illus., 1967.

Eleven species of trilobites have been recognized in the Silurian Henryhouse Formation. They have been described and illustrated (Campbell, in press) and all the available data on their distribution recorded. In this contribution the most significant features of the distribution for stratigraphic and zoogeographic studies are summarized.—Author's abstract

01982 **Canada Geological Survey.** Aeromagnetic map, Lac Néwiska, Quebec: Canada Geol. Survey Geophysics Paper 5356, scale 1:63,360, 1968.

02002 **Canada Geological Survey.** Aeromagnetic map, Gaudet, Quebec: Canada Geol. Survey Geophysics Paper 5357, scale 1:63,360, 1968.

02003 **Canada Geological Survey.** Aeromagnetic map, Jérémie, Quebec: Canada Geol. Survey Geophysics Paper 5358, scale 1:63,360, 1968.

02004 **Canada Geological Survey.** Aeromagnetic map, Wabimeig Lake, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3850, scale 1:63,360, 1968.

02005 **Canada Geological Survey.** Aeromagnetic map, Vanier, Quebec: Canada Geol. Survey Geophysics Paper 5354, scale 1:63,360, 1968.

02006 **Canada Geological Survey.** Aeromagnetic map, Lac Mistaouac, Quebec: Canada Geol. Survey Geophysics Paper 5355, scale 1:63,360, 1968.

07263 **Cantrell, Clyde Hull.** Scientist Benjamin L. C. Wailes [1797–1862]—The man and his books: Alabama Acad. Sci. Jour., v. 38, no. 2, p. 179–185, 1967.

Caplan, W. M. *See* Wise, O. A. 07269

Carlson, Paul R. *See* Nelson, C. Hans. 01920

Carmichael, Ian S. E. *See* Al-Rawi, Yehya. 07229

02047 **Carmichael, Robert Stewart.** Magnetomechanical behavior of nickel, cobalt, and magnetite and application to rock magnetism [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4631B, 1968.

01911 **Carmichael, Virgil W.** Procedures for rapid estimation of Fort Union coal reserves, *in* Technology and use of lignite—Bureau of Mines-University of North Dakota Symposium, Grand Forks, N. Dak., 1967, Proc.: U.S. Bur. Mines Inf. Circ. 8376, p. 10–18, illus., 1968.

Aerial photographs supplemented by instrumental leveling, barometric determination of elevations, and drilling are used to map lignite beds and to estimate reserves and amount of overburden.—APB

Carrier, J.-L. *See* Bernier, B. 02051

07304 **Carrington, Thomas J.** Stratigraphic revision in the Talladega Group as suggested by structural relationships, Chilton and Shelby Counties, Alabama [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 3, p. 231, 1967.

Carter, M. *See* Boyle, R. W. 02055

01819 **Carter, O. F.** Westfield Minerals Limited (Coniaurum), *in* Geology and ore deposits of Tisdale township: Ontario Dept. Mines Geol. Rept. 58, p. 153–158, tables, 1968.

The property covers the eastern extension of the Hollinger-McIntyre ore zone, and is on the north limb of the syncline. From 1928 to 1959, the Coniaurum mine produced 1,053,594 oz of gold and 186,714 oz of silver. Keewatin lava flows and tuffaceous sediments, Algoman quartz porphyry intrusives, and Keweenawan diabase dikes are present. The flows are divided into massive andesites or basalts, called greenstones, and pillow lavas. Secondary foldings occur along the anticline north of the ore zone, which follows the series of porphyry bodies rather than any flow unit. Veins are of the fracture-filling type, composed of quartz and carbonates, are related structurally and genetically to the porphyry, and occur within the porphyry at depth. Faulting is not extensive.—ESL

01794 **Cashman, C. Z.** Bed-load sampler developed for sediment studies: Ocean Industry, v. 3, no. 7, p. 84, 86, 88, illus., table, 1968.

A slightly modified Arnhem Sampler fabricated in the U.S. from the Netherlands design is described. The sampler was needed for collecting sediment along the St. Clair River bottom, in evaluating contribution of Lake Huron sediment to the river load, a phase of the Shore Processes project of the U.S. Lake Survey. The sampler is a catch basket with fin assembly designed to keep it parallel to direction of river flow; when the sampler rests on the bottom, tension on the two forward supporting cables is released and the basket mouth is in sampling position flush with the bottom. Samples were collected at maximum depth of 47 feet, with current speed of about 3 1/2 fps. The sampler appears satisfactory for determining bed-load movements; its most serious limitation is the need for an almost level river bottom for maximum effectiveness.—VMJ

01826 **Caudle, William N.** Canst work i' the earth so fast?: New Scientist, v. 38, no. 600, p. 528–530, illus., 1968.

Instrumented projectiles, penetrating the ground to a depth of 200 feet or more, can give some indication of the nature of the layers through which they pass, from deceleration measurements. This technique has strong possibilities for rapid remote surveying of difficult country. Findings by the Atomic Energy Commission's Sandia Laboratories in Albuquerque, N. Mex., support German ones in that a long slender

projectile penetrates better than a normal artillery shape; the length must be at least eight times greater than its diameter. Signals from the telemetry system are sent through a trailing line to transmitter on a stabilizing chute. The type of soil penetrated can be determined by comparison with known profiles, but to identify the precise kind of material is difficult. More refined projectiles and further tests are in progress.—GDC

Chagnon, Jean-Yves. *See* LaSalle, Pierre. 01976

07200 **Chao, G. Y.; Hounslow, A. W.** Monoclinic chlorapatite from Bob's Lake, Ontario [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 286, 1967.

07313 **Chao, G. Y.** Leucophanite, elpidite, and narsarsukite from the Desourdy quarry, Mont St. Hilaire, Quebec [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 286–287, 1967.

01855 **Chapman, S. L.; Horn, M. E.** Parent material uniformity and origin of silty soils in northwest Arkansas based on zirconium–titanium contents: Soil Sci. Soc. America Proc., v. 32, no. 2, p. 265–271, illus., tables, 1968.

Petrographic and X-ray spectrographic studies were made of 15 silty soils overlying various geologic materials to test for a loess vs. residual origin. The slight deviations with depth in zirconium and titanium contents point to absence of lithologic discontinuities in soils suspected of upper loess derivation. Prolonged weathering of local rocks with reworking by mass movements, water, and wind seems to have produced the homogeneous regolith on gentle slopes over cherty limestone and siltstone. Zr–Ti ratios were highest in soils over sandstone and lowest over cherty limestone; Zr was most abundant in coarse silts except for two soils over sandstone where it was most abundant in very fine sands, and Ti increased as particle size decreased. Leucoxene coatings on quartz grains of very fine sand indicate probable Ti translocation and its unsuitability as a stable constituent in soil genesis studies.—GDC

Cheng, F. S. *See* Bissada, K. K. 07317

Cheng, Francis S. *See* McAtee, James L., Jr. 07231

07211 **Chesworth, Ward.** The biotite–cordierite–almandite subfacies of the hornblende-granulite facies—A discussion [of paper by D. de Waard, 1966]: Canadian Mineralogist, v. 9, pt. 2, p. 263–268, illus., 1967.

The basis of de Waard's subdivision (ibid., v. 8, p. 481–492, 1966) of the granulite facies is questioned for the following reasons: (1) the choice of load pressure, temperature, and "water pressure" is not consistent with the physicochemical behaviour of real systems and (2) the subdivision of the facies is based on hypothetical reactions for which no evidence is offered. In the manner stated by de Waard, the simple criterion of coexistence of products and reactants of a particular reaction cannot be used to recognize a subfacies and isograds are not uniquely defined by the reactions used by de Waard.—BAM

Chin, George E. *See* Langton, J. Roger. 01716

Chipman, David W. *See* Noble, Donald C. 01931

02162 **Chisholm, L. R.** Smackover (Jurassic) reservoir of New Hope field, Franklin County, Texas, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 1069–1073, illus., 1968.

The New Hope field is in southeastern Franklin County, 10 mi south and slightly east of Mt. Vernon, the county seat. Geologically, it is along the northern margin of the East Texas basin, 20 mi south of the Mexia–Sulphur Bluff–Talco fault zone. Although production history of the New Hope field dates back to the early 1940's, this paper is limited to a discussion of the geology and reservoir characteristics of the Jurassic Smackover Formation.—Author's abstract

Christ, C. L. *See* Hostetler, P. B. 01978

07281 **Christensen, Cleo M.** Geology, Pt. 1 *in* Geology and water resources of Clay County, South Dakota: South Dakota Geol. Survey Bull. 19, 86 p., illus., geol. map, 1967.

Surficial sediments of Clay County consist of Pleistocene glacial deposits of Wisconsin and pre–Wisconsin ages and Recent deposits of windblown sand, alluvium and colluvium, with a maximum thickness of over 300 feet. Cretaceous sedimentary rocks underlie the above deposits and rest directly on Cambrian and Precambrian rocks. The Cretaceous sequence, maximum thickness over 700 feet, consists of the Niobrara Marl, Carlile Shale, Greenhorn Limestone, Graneros Shale, and the Dakota Group. Dolomitic siltstones and sandstones represent the Cambrian rocks in the subsurface, their thickness probably not exceeding 100 feet. Sioux Quartzite is thought to be the main Precambrian subcrop basement rock that is underlain by older granitic rocks. Outwash is in part buried and constitutes a major aquifer. Ground water, sand and gravel are the most important resources.—*from* Author's abstract

01965 **Christiansen, E. A.** A thin till in west–central Saskatchewan, Canada: Canadian Jour. Earth Sci., v. 5, no. 2, p. 329–336, illus., tables, 1968.

A thin till, commonly 1 to 10 ft thick, forms the uppermost till in an area of more than 20,000 sq mi in west–central Saskatchewan. The till, named herein the Battleford Formation, is gray to light olive–gray in contrast to the underlying pale olive and pale yellow till and stratified drift. The Battleford Formation was deposited about 20,000 years ago and is separated from the underlying older drift by a disconformity whose hiatus is about 15,000 years. These dates suggest that the weathering interval prior to the deposition of the Battleford Formation is Farmdalian and that the Battleford Formation is Woodfordian.—Author's abstract

Chronic, John. *See* Murray, D. Keith. 01712

Church, W. R. *See* Mottana, A. 07190

07201 **Church, W. R.** The occurrence of kyanite, andalusite, pyrophyllite and kaolinite in Lower Proterozoic (Huronian) rocks of Ontario [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 287, 1967.

Church, W. R. *See* Edgar, A. D. 07205

02027 **Clark, Bruce Robert.** The origin of slaty cleavage in the Coeur d'Alene district, Idaho [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4619B–4620B, 1968.

02133 **Clark, L. M.; Cleveland, C. E.; Johnson, Rolfe S.; Budd, Ronald C. M.** Geology of natural gas, Peace River area, Canada, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 683–697, illus., tables, 1968.

Gas has been found in strata ranging in age from Devonian to Cretaceous throughout a section about 20,000 feet thick. Gas is in anticlines and in several types of stratigraphic traps including fault traps, biohermal reefs, and others. The Peace River area comprises northwestern Alberta and northeastern British Columbia; the area in the Northwest Territories is not discussed in detail.—*from* Authors' abstract

02028 **Clark, Malcolm Mallory.** Pleistocene glaciation of the drainage of the West Walker River, Sierra Nevada, California [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4620B, 1968.

Clark, W. Kenley. *See* Hardin, George C., Jr. 02114

02063 **Clarke, D. B.** The basalts of Svartenhuk Peninsula, progress report, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 15–17, 1968.

Forty specimens of Tertiary basalt were selected for chemical analysis and comparison with those from southeast Baffin Island, Northwest Territories. The number of phenocryst phases increases from one to three as the rocks become younger; none are aphyric, signifying that no lava erupted above its liquidus temperature. Analyses of trace elements demonstrate a strong linear evolution of magma from primitive in the northeast to more highly evolved in the southwest. These basalts and those from Baffin Island have very low potash content, similar to deep ocean tholeiites, and are very primitive mantle derivatives representing successive differentiation products of one evolving source. Eruptions on Baffin Island began before those on western Greenland. It is concluded that the areas were separated by continental drift, probably during volcanism.—ESL

Cleary, J. R. *See* Hales, A. L. 01946

01793 **Cleaves, E. T.; Edwards, Jonathan, Jr.; Glasser, John D.** (compilers and editors). Geologic map of Maryland: [Baltimore, Md.] Maryland Geol. Survey, scale 1:250,000, sections, 1968.

Cleveland, C. E. *See* Clark, L. M. 02133

01720 **Clifton, H. Edward.** Gold distribution in surface sediments on the continental shelf off southern Oregon—A preliminary report: U.S. Geol. Survey Circ. 587, 6 p., illus., 1968.

Local concentrations of gold have been identified in surface sediments on the continental shelf off southern Oregon between Cape Arago and Cape Sebastian, a distance of about 40 miles. Concentrations of gold range from the lower limit of detection, 5 ppb, to almost 150 ppb. The largest gold anomaly is in an area of 15 to 20 sq mi off Cape Blanco. Gold is associated with black sands believed to be relict beach placers formed during a previous low stand of the sea. Although the gold content is low, it may indicate higher grade material at depth; drilling will be necessary to determine the economic potential of the placers.—Author's abstract

Coates, M. E. *See* Kumarapeli, P. S. 01958

02086 **Coffin, D. L.; Welder, F. A.; Glanzman, R. K.; Dutton, X. W.** Geohydrologic data from the Piceance Creek basin between the White and Colorado Rivers, northwestern Colorado: Colorado Water Conserv. Board Ground-Water Ser. Circ. 12, 38 p., illus., tables, 1968.

The Piceance Creek basin, a structural downwarp in northwestern Colorado, contains large accumulations of oil shale; its axis extends northwestward from about 20 miles northwest of Gunnison to the vicinity of Rangely. This report pertains to an area of about 1,600 sq mi in parts of Rio Blanco, Garfield, and Mesa Counties, and with a subsequent report on the water resources will be the basis for developing water supplies and for coping with water problems associated with exploitation of oil resources. Water-bearing characteristics of the Tertiary-Quaternary formations are summarized in a table; upper members of the Eocene Green River Formation and Quaternary alluvium have the greatest potential and reported yields. The appendix contains logs of test holes and observation wells drilled in alluvium, hydrographs, and chemical analyses and related physical measurements of ground water.—MCM

01795 **Cohen, Philip; Franke, O. L.; Foxworthy, B. L.** An atlas of Long Island's water resources: New York Water Resources Comm. Bull. 62, 117 p., illus., 1968.

This report aims to summarize and interpret for the citizens of Long Island, N. Y., as well as for scientist and professional water manager, some major results of a 30-year cooperative program of investigation of its water resources by the U.S. Geological Survey and various state and local county agencies. Most of the reports, scientific in nature, have been published, giving hydrologic data. This report considers briefly and graphically: the natural hydrologic system of Long Island, effects of man's activities on the system, and the yield and alternative methods of developing and managing the system. Quantitative estimates of its various

components, as developed in previous studies and supplemented by new estimates are given.—GDC

01830 **Colbert, Edwin H.** Men and dinosaurs—The search in field and laboratory: New York, E. P. Dutton and Co., 283 p., illus., 1968.

The story of the long hunt for dinosaurs during the last 150 years, and of the men who dug them out, studied and interpreted them, and set them up in museums, is told here. The 10 chapters cover: the first discoveries, dinosaurs come to life, skeletons in the earth, two evolutionary streams, the oldest dinosaurs, Jurassic giants of the western world, Canadian dinosaur rush, Asiatic dinosaur rush, below the equator, and closing the circle. The text is illustrated by numerous photographs and line drawings.—ESL

01876 **Cole, W. Storrs.** More on variation in the genus *Lepidocyclina* (larger Foraminifera): Bulls. Am. Paleontology, v. 54, no. 243, p. 295–327, illus., tables, 1968.

This article is primarily a study of variation in the American Oligocene *Lepidocyclina vaughani* Cushman (1919). Also, additional data are presented on the development of multilocular embryonic chambers in the genus, and the subgeneric classification is revised. *Lepidocyclina* is subdivided into subgenera *Polylepidina* and *Lepidocyclina s.s. (Eulepidina and Pliolepidina* being considered junior synonyms of *Lepidocyclina s.s.).* Six specific names as applied to American (not Old World) specimens, *tournoueri, verbeeki, tempanii, dartoni, crassimargo, and lehneri,* are here referred to *L. Lepidocyclina) vaughani.* Type localities of certain American Oligocene species of larger Foraminifera are reviewed; it is demonstrated that the faunal associations at these localities are widespread in the Caribbean region.—VMJ

01932 **Coleman, R. G.; Papike, J. J.** Alkali amphiboles from the blueschists of Cazadero, California: Jour. Petrology, v. 9, no. 1, p. 105–122, illus., tables, 1968.

Alkali amphiboles from these rocks, and comparable New Caledonian rocks, have been characterized by X-ray crystallographic, optical, and chemical methods. The composition of any particular alkali amphibole is controlled by the bulk rock composition, but within the blueschist facies metamorphic zones are not characterized by changes in amphibole composition. All amphiboles studied herein belong to the $C2/m$ space group and show that complete miscibility between glaucophane and riebeckite prevailed during metamorphism in the blueschists. Linear relationships are found between unit-cell dimensions and variations in composition between glaucophane and riebeckite. The glaucophanes belong to the high pressure-low temperature series. Limited miscibility of actinolite in glaucophane may be characteristic of blueschist facies.—*from* Authors' abstract

02029 **Collins, Kenneth Alan.** Phase distributions of the rare-earth elements in sediments [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4620B–4621B, 1968.

01900 **Collins, Lorence G.** Trace ferrides in the magnetite ores of the Mount Hope mine and the New Jersey highlands [discussion of paper by A. H. James and W. H. Dennen, 1962]: Econ. Geology, v. 63, no. 2, p. 193–195, 1968.

Because of marked differences between trace ferride content of ore magnetite and that of disseminated wall-rock magnetite, James and Dennen concluded (ibid., v. 57, p. 439–499, 1962) that the ore was not concentrated by lateral secretion, and instead had a magmatic source. This conclusion is not valid if the ferromagnesian silicates of the host rock were an important source of the iron. In this latter case, the differences between ore and host-rock magnetite and observed regional differences in ferride content can be attributed to differences in host-rock composition or to degree of recrystallization.—WSW

07225 **Colville, Alan A.; Staudhammer, Karl.** A refinement of the structure of barite: Am. Mineralogist, v. 52, nos. 11–12, p. 1877–1880, illus., tables, 1967.

A new three-dimensional refinement of barite, $BaSO_4$ was undertaken with 400 observations measured using counter techniques. New unit-cell data, atomic positions, and bond lengths are given.—MR

Constantin, G. K. *See* Waldron, L. J. 01853

01894 **Cooke, C. Wythe.** Barrier island formation—Discussion [of paper by J. H. Hoyt, 1967]: Geol. Soc. America Bull., v. 79, no. 7, p. 945–946, 1968.

In discussion of Hoyt's (ibid., v. 78, no. 9, p. 1125–1135, 1967) thesis for formation of barrier island accompanied by slow submergence, Cooke points out that barrier islands may be formed without a change of sea level or with emergence rather than submergence. The Hatteras Banks are cited as a typical example of development of bars and landward migration without noticeable sea-level changes, and the Florida Keys as examples of barrier islands produced by emergence.—VSN

02118 **Cooke, W. F., Jr.** West Bernard area, Wharton County, Texas, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 340–358, illus., tables, 1968.

The West Bernard area encompasses eight gas fields. The total reserve (502 bcf) is mostly in two fields—West Bernard, in which the structure is a large low-relief Yegua anticline, and Spanish Camp, in which the structure is a prominent Miocene anticline. The most important and outstanding structural element is a Frio Vicksburg isopachal anticline which covers the entire area. Stratigraphy is a major factor in effecting accumulation, particularly in the formation of many small pools. The most interesting and important stratigraphic feature is the West Bernard field Clodine (Yegua) sandstone bar which contains about one-tenth of the gas reserves. Oil has not been found in commercial quantities.—*from* Author's abstract

Cooley, M. E. *See* Arteaga, F. E. 01879

01886 **Coope, G. R.** Insect remains from silts below till at Garfield Heights, Ohio: Geol. Soc. America Bull., v. 79, no. 6, p. 753–755, 1968.

Insect fragments were collected from near the base of a sequence of laminated silts in an old gravel pit in the Mill Creek Valley, Garfield Heights, Ohio. On the same level as this band and about six feet away was a large tree trunk. From a similarly placed trunk, radiocarbon dates of about 24,000 years B.P. have been obtained. Many insect fragments represent species still living in North America and thus provide information about the local environment that prevailed when the silts were deposited. The climate suggested is similar to that which may be found close to the timber line of the present day. Though cooler than now, conditions were not really arctic. The country was open, rather barren, with very few trees, a scattered vegetation of low plants, carpets of moss, and places that were quite bare.—CCC

01878 **Cooper, James B.; John, Edward C.** Geology and ground-water occurrence in southeastern McKinley County, New Mexico: New Mexico State Engineer Tech. Rept. 35, 108 p., illus., tables, geol. map, 1968.

Southeastern McKinley County, in the southern part of the San Juan structural basin, is topographically diverse. Rocks exposed range from Permian to Quaternary, with beds dipping N and NE toward the center of the basin at angles of 3–5°. Ground water is obtained from at least 16 distinct aquifers: Permian Glorieta Sandstone and San Andres Limestone and Triassic Chinle Formation are principal sources (300 gpm) in the southwestern section, Westwater Canyon Member of the Jurassic Morrison Formation in the central area, and units of Cretaceous Mesaverde Group in the remainder. Wells range from 20 to more than 1,200 feet, water levels from above land surface to about 800 feet below. Although chemical quality is variable, most water is suitable for domestic use and livestock. Withdrawals have increased since 1951 due to mining in the Ambrosia and Smith Lakes areas.—*from* Authors' abstract

02111 **Corpus Christi Geological Society.** Natural gas in post-Eocene formations of South Texas, *in* Natural gases of North America—Pt. 1, Natural gases in rocks

of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 233–263, illus., tables, 1968.

This review of natural gas in South Texas encompasses the Oligocene Vicksburg through the Miocene Fleming Formations. Most of the gas accumulation is related to normal faulting associated with subsidence toward the gulf. Some gas-bearing structures seem to be related to deep salt movement. The gas-bearing sandstones are variable, and while some calcareous cement occurs, no limestone reservoirs are known. Principal traps are anticlines (simple and fault-related), domes related to deep salt movement, stratigraphic traps (permeability change), and fault closures. The area is now in the mature stage of gas development, most of the large gas-bearing features having been outlined.—*from* Authors' abstract

02112 **Corpus Christi Geological Society.** Mustang Island–Red Fish Bay area, Nueces County, Texas, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 264–270, illus., tables, revised 1968; originally published by Travis Hicks, 1952.

The Mustang Island–Red Fish Bay area is in the extreme northeastern part of Nueces County, Texas, and is adjacent to and west of Mustang Island in Corpus Christi and Red Fish Bays. The discovery of oil in the area in 1949 is accredited to reflection-seismograph surveys. Both oil and gas are produced from multiple sandstone bodies, as in many other South Texas fields. Productive reservoirs are in the *Marginulina* zone and the marine Frio Formation. The structure is a symmetrical anticline traversed by normal faults.—Author's abstract

01814 **Corry, Charles; Dubois, Carl; Vacquier, Victor.** Instrument for measuring terrestrial heat flow through the ocean floor: Jour. Marine Research, v. 26, no. 2, p. 165–177, illus., 1968.

Heat flow through the ocean floor is determined by measuring temperature gradient and thermal conductivity in the upper few meters of sediment with an instrument lowered on hydrographic wire. The novel feature is that thermal conductivity is measured in situ simultaneously with gradient instead of in a cored specimen. The instrument consists of a heavy case containing the recorder, to the lower end of which is fastened a hollow steel probe carrying three thermistors 1 m apart. Two independent values of the temperature gradient are thus obtained. Thermal conductivity is measured by the Von Herzen–Maxwell needle-probe method, using a needle 23 cm long mounted on a body that slides upward on the probe during penetration, and electrically connected to the recorder. Water temperature vs. depth can be measured near the bottom by raising the instrument in small steps after heat-flow measurement.—*from* Authors' abstract

02075 **Cotter, R. D.; Bidwell, L. E.** Water resources of the Lac qui Parle River watershed, southwestern Minnesota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-269, 4 sheets, scale 1:250,000, text, 1968.

Most water used in the Lac qui Parle River watershed is from three aquifers: surficial sand and gravel, yield up to several hundred gpm of good quality water commonly hard and high in iron; buried sand and gravel, several hundred gpm, quality similar to that in surficial deposits; Cretaceous sandstone or sand, yield less than 100 gpm. None of the aquifers are being fully utilized. The sheets contain information on water budget, summary of water uses and sources, aquifers and yields, surface water, quality of water, and municipal-supply potential and water use.—MCM

02117 **Craig, Jack W.** Occurrence of gas on northwest flank of South Liberty Dome, Liberty County, Texas, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 330–339, illus., tables, 1968.

Commercially profitable reserves of gas now have been found on the northwest flank of South Liberty dome and should encourage geologists to reevaluate and give closer scrutiny to similar possibilities on the flanks of other piercement salt domes in this trend. There is a paucity of test wells drilled to the Yegua–Cook Mountain on

the flanks of the other piercement domes in this trend, and in most wells only the Cockfield or upper Yegua sections have been tested. When more wells in the 15,000-20,000-ft depth range are drilled in this trend, there is a good possibility that large reserves of hydrocarbons, especially gas and condensate, will be discovered on the flanks of the domes.—Author's abstract

01699 **Crickmay, C. H.** Discoveries in the Devonian of western Canada: Calgary, Alberta, Evelyn de Mille Books, 12 p., illus., 1968.

Corrections and new information are here set forth pertinent to the author's work on Devonian stratigraphy and paleontology of western Canada (Crickmay 1952, 1953, 1960, and his contributions to the *Treatise on invertebrate paleontology*, Pt. H, Brachiopoda, 1965). Correlation and nomenclature of the Beavertail, "Kee Scarp" and Ramparts Formations in the Norman Wells area of western Northwest Territories are clarified, and the tetracoral *Alaiophyllum mackenziense* Pedder 1963 is cited as guide fossil to the Beavertail. On the basis of transverse section series studies, brachiopod species of *Basilicorhynchus, Warrenella, Stringocephalus*, and *Geranocephalus* are redescribed, and new species of *Innuitella* (new rhynchonelloid family and genus), *Spirinella*, and *Stringocephalus* (3 n.spp.) are described and illustrated.—VMJ

07288 **Crowe, Christopher.** Expanding opportunities in the earth sciences: Earth and Mineral Sci., v. 37, no. 1, p. 1-8, illus., 1967.

Career opportunities, especially in research, increase as our knowledge of Earth and its environment grows. The approach to applied science is becoming more interdisciplinary, and scientists are being brought together more. Innovation results in new applications of earth sciences. Some applications are discussed in petroleum and mineral exploration; water supply development and management; agriculture, wild life, and urban studies; monitoring and control of the environment; military problems, including nuclear explosions; and lunar and planetary exploration.—ESL

01743 **Crowley, William Patrick.** Stratigraphic interpretation of metaigneous rocks in south-central Connecticut—Bedrock geology of Long Hill and Bridgeport 7 1/2' quadrangles, Connecticut [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4173B, 1968.

01808 **Cummings, David.** Geologic map of the Zuni Salt Lake volcanic crater, Catron County, New Mexico: U.S. Geol. Survey Misc. Geol. Inv. Map I-544, scale 1:6,000, section, 1968.

Cunningham, R. L. *See* Petersen, G. W. 01854

Curtis, Bruce F. *See* Beebe, B. Warren. 02093

01916 **Curtis, C. D.; Spears, D. A.** The formation of sedimentary iron minerals: Econ. Geology, v. 63, no. 3, p. 257-270, illus., 1968.

An attempt to combine laboratory and field data on recent sedimentary environments to produce mineral stability diagrams suggests that two distinct situations may be recognized. In depositional water, only ferric compounds can be truly stable. In interstitial water, beneath the sediment-water interface, ferrous compounds (pyrite, pyrrhotite, magnetite, siderite, and chamosite) are stable. Anion activity (sulfide and carbonate) appears to be the most important chemical control. The theoretical findings (Pt. 1 by C. D. Curtis) are consistent with interpretation of petrographic observations on Carboniferous and Jurassic ores of the British Isles (Pt. 2 by D. A. Spears).—WSW

Custer, Richard L. P. *See* Hood, William C. 07315

01834 **Dacey, Michael F.** The profile of a random stream: Water Resources Research, v. 4, no. 3, p. 651-654, 1968.

A probabilistic formulation is given for the profile of a stream. The elevation of a stream is considered at successive points j, $j = 1,2,\ldots$, that have equidistant spacing

along the stream. The basic assumptions of the model are (1) between the jth and $(j+1)$th points stream elevation remains constant or drops by a unit of elevation, and (2) the probability of p of decrease between the jth and $(j+1)$th points is independent of j. Two formulations of the model are examined by assuming that p is constant throughout the stream length, and that p is a random variable. The model is analyzed for these two cases, and results include the frequency functions, means, and variances of length of stream from its origin to 'sea-level' and for elevation of stream at each point j.—Author's abstract

01985 **Damon, Paul E.** Behavior of some elements during magmatic crystallization: Geochim. et Cosmochim. Acta, v. 32, no. 5, p. 564–567, table, 1968.

Following concepts first introduced by Pauling, a simple equation can be derived for prediction of single bond energies for diatomic molecules. For transition elements an additional term must be added to account for crystal field stabilization. When allowance is made for multiple bonds, this equation provides a quantitative substitute for Goldschmidt's rules. It has the added advantage of also incorporating the influence of electronegativity differences.—Author's abstract

02173 **d'Anglejan, Bruno F.** Phosphate diagenesis of carbonate sediments as a mode of in situ formation of marine phosphorites—Observations in a core from the eastern Pacific: Canadian Jour. Earth Sci., v. 5, no. 1, p. 81–87, illus., table, 1968.

Carbonate-fluorapatite, the mineral of marine phosphorite, is found to form contemporaneously within the sediments by the replacement of skeletal carbonate in a core sample of foraminiferal ooze from the eastern tropical Pacific. A systematic downward increase in apatite within the core suggests that replacement is continuing at a decreasing rate in the sediments. The widespread distribution of foraminiferal ooze on the California borderland and its common association with phosphorite suggest that this material may play a role in the phosphorite accumulation there. The reaction of $CaCO_3$ with soluble phosphate in conditions favoring the slow dissolution of the carbonate mineral may result within the sediments in an increase of the carbonate ion concentration, which appears to control the rate of replacement.—Author's abstract

01993 **Davis, G. A.** Westward thrust faulting in the south-central Klamath Mountains, California: Geol. Soc. America Bull., v. 79, no. 7, p. 911–934, illus., geol. map, 1968.

Structural studies in the Cecilville quadrangle indicate tectonic imbrication of three of the four Klamath geologic subprovinces along regional thrust plates. Minimum westward displacements of 15–20 miles are estimated. Relationship of a sheetlike ultramafic pluton to the thrust zone is not resolved; the pluton may have been injected along the thrust during Jurassic(?) thrusting or it may have intruded Paleozoic rocks during Devonian(?) regional metamorphism. Westward thrusting here agrees with westward thrusting elsewhere in Cordilleran eugeosynclinal areas. Thrusting and accompanying injection of mantle peridotites along the faults are explained by periodic underthrusting of the continental margin by an active oceanic block.—EHP

Davis, G. L. *See* Wetherill, G. W. 01903

01880 **Davis, James F.** Lore, lode and lade—Emery, Westchester's own nitty gritty: Empire State Geogram, v. 5, no. 3—v. 6, no. 1, p. 14–19, illus., 1968.

Emery deposits in the Peekskill area are the only ones actively mined in the Western Hemisphere. Indians knew about the deposits which were not mined until 1889. The deposits are associated with the Cortlandt norite complex intruded through feeder pipes. Hornblende- and biotite-bearing phases of the norite have been interpreted as products of magmatic crystallization, and large hornblende as poikoblastic. Constituents left from this replacement may have been important in emery formation. The deposits are limited in size, of irregular shape, and consist of black and gray varieties; they occur along the contact of the complex with the alumina-rich Manhattan Schist. Friedman proposes that black ore results from alteration of norite, and gray from alteration of schist, and that the impetus came

from intrusion of the Peekskill Granite. Production statistics for 1911 to 1964 are graphed.—ESL

01934 **Davis, James F.; Ming, Roger W.** Earth science in New York State secondary schools—Who's doing what and to whom?: Empire State Geogram, v. 5, no. 3—v. 6, no. 1, p. 11–14, illus., 1968.

In 1966, 42,000 students wrote Earth Science Regents examinations, about four percent of the total enrollment, as compared with 0.3 percent in 1945. Since 1963, teachers are required to have four years of earth science and mathematics courses in addition to regular requirements, but most instructors now in the system do not meet this regulation. The Regents curriculum consists of one semester of geology, six weeks of astronomy, and ten weeks of meteorology. The experimental curriculum worked out under the American Geological Institute project is being tried out in nine centers with 51 teachers.—ESL

01935 **Davis, James F.** Higher geological education in New York—Decade of decline: Empire State Geogram, v. 5, no. 3—v. 6, no. 1, p. 2–10, illus., tables, 1968.

The history of higher geological education in New York during the past decade is summarized and it is shown that the number of Bachelors and Masters degrees has declined; geology Doctorate programs have expanded, but New York growth is below national level with the annual number of advanced degrees in New York making an irregular decline. In 1966, the total of full-time faculty members in geology degree-granting departments in the State had increased 80 percent; the undergraduate geology-major population follows nation-wide trends, with employment the principal factor.—ESL

Davis, L. A. *See* Gordon, R. B. 01952

01866 **Dawes, Peter R.** Geological investigations on Dalagers nunatakker, with special reference to metamorphosed basic dikes, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 35–40, 1968.

Metamorphosed mafic dikes of different ages have been mapped within the Precambrian gneiss complex of a group of nunataks in the Frederikshaabs Isblink area. The oldest recognizable dikes are composed of amphibolite and have been encroached upon by the gneiss; some cut amphibolitic enclaves. Later metamorphosed dikes postdate main phases of migmatization and granitization; three generations can be recognized. Reworking of the gneiss occurred at least at two different times postdating the metavolcanics. Features suggest an early granulite facies metamorphism, now retrogressed to amphibolite. Pre-Gardar(?) dolerite dikes in the south are fresh with chilled borders; in the north, margins are sheared and dikes slightly metamorphosed. The dikes are useful in separating plutonic events.—ESL

01726 **Dean, Walter Edward, Jr.** Petrologic and geochemical variations in the Permian Castile varved anhydrite,Delaware basin, Texas and New Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3749B, 1968.

02074 **DeBuchananne, George D.** Ground-water resources of the James, York, and Rappahannock River basins of Virginia, west of the Fall Line: U.S. Geol. Survey Hydrol. Inv. Atlas HA-283, scale 1:500,000, text, 1968.

Compiled records indicate that industrial and public ground-water developments have tapped only about one percent of potentially available ground water in this area of central Virginia. Calcareous aquifers underlying part of the James River basin in the Valley and Ridge province have a potential yield of 500,000 gpd per sq mi; crystalline rocks within the Blue Ridge and Piedmont provinces are capable of yielding 400,000 gpd per sq mi. Wells drilled in crystalline and calcareous rocks normally do not have high yields, but favorable hydrogeologic conditions occur in several areas. Sufficient criteria have not been developed to help locate new high producing areas. In general, water is of good quality and suitable for public supply. Maps show availability and quality of ground water, and ground-water use.—MCM

07307 **Deininger, Robert W.** Some previously unreported details on locations of diabase dikes in Lee and Chambers Counties, Alabama [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 3, p. 229–230, 1967.

07312 **Deininger, Robert W.** Some petrologic variations among diabase dikes in Lee and Chambers Counties, Alabama [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 4, p. 341, 1967.

DeVoto, Richard H. *See* Murray, D. Keith, 01712

01841 **Dibblee, T. W., Jr.** Geology of the Fremont Peak and Opal Mountain quadrangles, California: California Div. Mines and Geology Bull. 188, 64 p., illus., geol. maps, 1968.

Distribution, name, landform, field relations, lithology, age, and correlation of Mojave Desert rock units in these quadrangles are described. The pre-Tertiary basement complex—Mesozoic? granitic plutons enclosing pendants of Precambrian? gneiss—is cut by felsitic to porphyritic dikes, Cretaceous or younger. The Tertiary sequence includes new Jackhammer and Pickhandle Formations with associated Opal Mountain Volcanics; the Barstow Formation, redefined to include the here named basal Owl Conglomerate Member; and the Lane Mountain Andesite. Black Mountain Basalt of Quaternary age, alluvium, and other sediments are on the beveled surface. In a syncline cut by 3 NW-trending high-angle fault zones are folded Tertiary formations in an unstable block. Small amounts of pumice, perlite and quartz, placer gold and strontianite have been produced.—GDC

07250 **Dickey, Parke A.** The geological significance of abnormal pressures in oil and gas wells [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 285, 1967.

01693 **Dickinson, Kendell A.** Upper Jurassic stratigraphy of some adjacent parts of Texas, Louisiana, and Arkansas: U.S. Geol. Survey Prof. Paper 594-E, p. E1–E25, illus., table, 1968.

Upper Jurassic formations described include Smackover, Buckner, Bossier, and Schuler in approximately ascending order. The Smackover is divided into: lower, silty limestone, found throughout the area; middle, mostly micritic limestone; and upper, mostly oolitic limestone—all restricted to marginal areas of the basin's north side. The Buckner, also restricted to the basin margin, is mostly anhydritic nodular mudstone and anhydrite. The Bossier, fossiliferous calcareous splintery shale in the central basin, represents the lateral equivalent of middle and upper Schuler. The Schuler contains a nonmarine facies—sideritic shale and lenticular bodies of fine-grained sandstone; and a marine facies—fossiliferous calcareous shale and widespread thin units of fine-grained sandstone.—KAD

Dillé, Alan C. *See* Osmond, John C. 02108

07242 **Dillon, Edward L.** Modern geology requires modern technology [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 277, 1967.

02102 **Ditzler, Clark C.; Vaughan, Richard H.** Brentwood oil and gas field, Contra Costa County, California, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 104–112, illus., table, 1968.

The Brentwood field was originally for gas alone; oil was discovered in 1962. The Paleocene and Cretaceous reservoir beds dip gently northward and are truncated by a southward-dipping unconformity overlain by the widespread "Meganos gorge" shale unit (Eocene) providing the trap. Northwest-striking normal faults are also present. Oil comes from three massive sands interbedded in shale; these are late Cretaceous and Paleocene in age. Gas overlies the oil in columns upwards to 250 feet thick. Thinly bedded sands in the Martinez Formation, known as the "Heidhorn" and "Ginochio" sands, produce dry gas. The quality of the gas from the field is exceptionally high for the region.—*from* Authors' abstract

01727 **Doheny, Edward John.** Petrology and subsurface stratigraphy of the Detroit River Formation (Middle Devonian) in northern Indiana [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3749B–3750B, 1968.

07203 **Dolar-Mantuani, L. M.** Petrography of an alkali-silica reactive rock in the Canadian Shield [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 287–288, 1967.

01756 **Domenico, Patrick Anthony.** Valuation of a ground-water supply for management and development [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4188B, 1968.

Donahue, Jack. *See* Krinsley, David H. 01888

07204 **Donnay, G; Donnay, J. D. H.** More precession goniometry [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 288, 1967.

Donnay, J. D. H. *See* Donnay, G. 07204

01990 **Dormaar, J. F.** Infrared absorption spectra of mineral matter in saxicolous lichens and associated mosses: Canadian Jour. Earth Sci., v. 5, no. 2, p. 223–230, illus., 1968.

Saxicolous lichens, associated mosses, and their weathered and fresh rock zones were collected from several locations. All material was treated with H_2O_2. Infrared spectra of the remaining mineral matter obtained differ from those of the substrata. Quartz and dioctahedral structures could be products of weathering of rocks by lichens and mosses. Saxicolous lichens may obtain at least part of their minerals from the substrata. Perioxidation of organic tissues, with Ca present, leads to formation of calcium oxalate; relative intensities of bands related to it, especially those at 1325 and 780 cm^{-1}, may be used to assess amount of Ca present. This intensity change may be a useful criterion in evaluating transformation of Chernozemic to Podzolic humic acids in soil.—*from* Author's abstract

01945 **Dorman, LeRoy M.** Anelasticity and the spectra of body waves: Jour. Geophys. Research, v. 73, no. 12, p. 3877–3883, illus., 1968.

A method is given for the determination of 1/Q and its frequency and range dependence, using the spectral shift of body waves. By means of this method, the effective Q for compressional waves in the upper 125 km of the Earth in north-central United States is found to be about 475.—Author's abstract

02167 **Dosso, H. W.; Jacobs, J. A.** Analogue model measurements of electromagnetic variations in the near field of an oscillating line current: Canadian Jour. Earth Sci., v. 5, no. 1, p. 23–29, illus., 1968.

Measurements of electric and magnetic fields for model earth–sea interfaces are compared with results reported earlier for an overhead sheet current. A truncated cone representing a circular sea, a graphite wedge representing an ocean coastline, and a graphite wedge underlain by a graphite block representing an upwelling conducting zone in the mantle near a sea coast are considered. In some cases results for the line current model differ appreciably from those for the sheet current, indicating that the nature of the source field can be an important factor in determining behavior of field components. Model measurements indicate that presence of the sea alone cannot account for coastal magnetic field anomalies. Results obtained support the idea that experimentally observed coastal magnetic field anomalies can sometimes be explained by assuming an upwelling conducting zone within the mantle.—*from* Authors' abstract

Dowling, J. J. *See* Hales, A. L. 02015

02017 **Dowling, John J.** The East Coast OnShore-OffShore Experiment—[Pt.] 2, Seismic refraction measurements on the continental shelf between Cape Hatteras and Cape Fear: Seismol. Soc. America Bull., v. 58, no. 3, p. 821–834, illus., tables, 1968.

During the East Coast OnShore–OffShore Experiment (ECOOE) two lines of instrumented buoys were anchored on the continental shelf between Cape Hatteras and Cape Fear. One line extended from near shore to the 100 fathom depth contour. The other line was parallel to and near the 100 fathom depth contour. Shots varying in size from 20 lb to 10 tons were fired along both lines. From the refraction data obtained and well control available, crystalline basement is correlated with a layer of velocity 5.96 kmps, the top of the Lower Cretaceous with a layer of velocity 3.54 kmps and the top of the Upper Cretaceous with a layer of 2.44 kmps. A contour map of the depth to crystalline basement under the shelf and structure sections are presented. The statistical uncertainties in the depths and velocities were determined.—Author's abstract

Doyle, H. A. *See* Hales, A. L. 01946

Drake, Charles L. *See* Sheridan, Robert E. 01997

Drake, David E. *See* Gorsline, Donn S. 01904

02104 **Dryden, J. E.; Erickson, R. C.; Off, T.; Yost, S. W.** Gas in Cenozoic rocks in Ventura–Santa Maria basins, California, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 135–148, illus., table, 1968.

The occurrence of natural gas in the Santa Maria and Ventura basins comprises only a small part of the hydrocarbons found to date. The preponderance of gas occurs in direct association with the oil, either as solution gas or, rarely, as gas caps. There are 16 known natural gas accumulations with the largest concentration located along the Santa Barbara coast line. There the age of the producing formations is largely restricted to Oligocene and lower Miocene sandstone.—Authors' abstract

Dubois, Carl. *See* Corry, Charles. 01814

02030 **Duffield, Wendell Arthur.** The petrology and structure of the El Pinal tonalite, Baja California, Mexico [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4621B, 1968.

Dukleth, Gordon W. *See* Jansen, Robert B. 01937

01845 **Duluk, Cecilia E.** Hunting ghosts, blobs, and assorted monsters in Illinois' coal age nodules: Earth Sci., v. 21, no. 4, p. 156–160, illus., 1968.

Animal remains in concretions of the Pennsylvanian Francis Creek Shale in the strip coal mine area, Illinois, have been divided into the Braidwood concretion fauna (terrestrial) and the Essex concretion fauna (marine-dominated). Some blobs are considered to be animal forms with only soft parts; other fossils are mollusks, crustaceans, and echinoderms. Suggestions for collecting are given.—ESL

Duncan, John R. *See* Nelson, C. Hans. 01920

01799 **Dunkle, David H.** *Stegosaurus*—Its bones and some tales: Explorer, v. 10, no. 2, p. 6–9, illus., 1968.

Apropos of the new life-size restoration of the Jurassic dinosaur *Stegosaurus* as an outdoor display of the Natural Science Museum, Cleveland, Ohio, Dunkle gives a brief, popular account of the history of the original discoveries of the bones, during the 1870's, in the Morrison Formation of Colorado and Wyoming, and of the subsequent attempts at restorations of the beast, here illustrated by sketches.—VMJ

07243 **Dunlap, William H.** Chaveroo revisited [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 278, 1967.

02031 **Dunn, David Lawrence.** Conodont biostratigraphy and the Mississippian–Pennsylvanian boundary and Morrowan Series in western United States [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4621B–4622B, 1968.

Durham, C. C. *See* Boyle, R. W. 02055

Dutton, C. E. *See* James, H. L. 01692

Dutton, X. W. *See* Coffin, D. L. 02086

01882 **Dyck, Willy.** Radon-222 emanations from a uranium deposit: Econ. Geology, v. 63, no. 3, p. 288–289, illus., 1968.

A method of collecting and measuring radon emanating from the soil above a uranium deposit near Bancroft, Ontario, gives results that are comparable to scintillometer readings and can detect uranium occurrences at greater depth.—WSW

01941 **Dymond, J. R.; Watkins, N. D.; Nayudu, Y. R.** Age of the Cobb seamount: Jour. Geophys. Research, v. 73, no. 12, p. 3977–3979, table, 1968.

The magnetic polarity and age of the Cobb seamount off the coast of Washington, located in a region of suspected crustal spreading, have been investigated on two samples of basalt boulders. The K–Ar age of the one acceptable sample is clearly younger than the 3.5-m.y. age of the crust inferred from the sea-floor spreading model, but the sample probably represents a very young phase in the seamount's volcanic history. The date and reversed polarity do not exclude the possibility that the seamount may be composed of material less than 3.5 m.y. old, suggesting that the crustal spreading model is not necessarily invalidated locally as suggested by Budinger and Enbysk (1967).—DBV

01844 **Earth Science.** Christina Cleburn: Earth Sci., v. 21, no. 4, p. 150–153, illus., 1968.

In 1966, Christina Cleburn discovered a complete crinoid head in freshly quarried limestone of the Pennsylvanian LaSalle Formation in a quarry in Livingston County, Ill. A crinoid colony grown in a depression in the limestone was found after a two-month search. She recognized the importance of the find and called in expert help. This echinoderm fauna is more prolific and better preserved than any other reported from the Pennsylvanian. Starfish and brittle stars are currently being studied and the morphology of the crinoids will be published by the University of Kansas Paleontological Institute. The primary study collection will be reposited with the Illinois Geological Survey. If all amateur paleontologists were oriented to help of this kind, it would provide an unprecedented boost to scientific research.—ESL

Edenharter, A. *See* Nowacki, Werner. 07291

Edgar, A. D. *See* Sood, M. K. 07180

Edgar, A. D. *See* Mottana, A. 07190

07205 **Edgar, A. D.; Mottana, A.; Church, W. R.** A chemical and X-ray study of omphacitic pyroxenes [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 288–289, 1967.

02132 **Edmonton Geological Society.** Geology of natural gas in Mesozoic strata of western Canada plains, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 671–682, illus., 1968.

Cretaceous sandstone constitutes most of the Mesozoic gas reservoirs in Alberta. Traps are formed by lenticularity and updip shale-out of sandstone bodies on the broad westward-dipping homocline that extends from the Foothills east to lap onto the Canadian shield. Gross Mesozoic reserves discovered (1965) are approximately 20 trillion cu ft.—Author's abstract

Edwards, Jonathan, Jr. *See* Cleaves, E. T. 01793

02032 **Eggler, David Hewitt.** Structure and petrology of the Virginia Dale ring-dike complex, Colorado-Wyoming Front Range [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4622B, 1968.

Elliott, Raymond L. *See* Reed, Bruce L. 01709

01928 **Emery, K. O.; Kaye, C. A.; Loring, D. H.; Nota, D. J. G.** European Cretaceous flints on the coast of North America: Science, v. 160, no. 3833, p. 1225–1228, illus., 1968.

Flint pebbles and nodules from the Upper Cretaceous chalks of Europe occur offshore and at many seaports along the Atlantic coast of North America, where they were brought as ship's ballast. Isolated pieces imported from Europe as gunflints also are present.—Authors' abstract

Emiliani, C. *See* Smith, P. B. 01881

01923 **Engdahl, Eric R.** Seismic waves within Earth's outer core—Multiple reflection: Science, v. 161, no. 3838, p. 263–264, illus., tables, 1968.

Seismic waves reflected as many as four times within Earth's outer core are routinely recorded from large earthquakes. Observations of these waves are confined to rays near grazing incidence on the core-mantle boundary, in agreement with theoretical expectation. Minor adjustments to outer-core velocities may be necessary to account for certain of these arrivals that are not predicted by present core models. A change of 10 km or more in the currently accepted core radius, 3473 km, is not corroborated by the new data.—Author's abstract

01711 **Englund, Kenneth J.** Geology and coal resources of the Elk Valley area, Tennessee and Kentucky: U.S. Geol. Survey Prof. Paper 572, 59 p., illus., tables, geol. maps, 1968.

The Elk Valley area, at the southwest corner of the Cumberland overthrust sheet, is underlain mostly by coal-bearing rocks of Pennsylvanian age. Displacement of the overthrust sheet is approximately 11 miles northwestward on the Pine Mountain overthrust fault which is exposed in a mile-wide zone of imbricate fault slices and klippen. The coal is of high-volatile A bituminous rank, low in ash and sulfur, and occurs in 17 commercially important beds. Mining since the early 1880's has depleted about 5.5 percent of the total estimated reserve of 1 billion tons in beds more than 14 inches thick. Of this total, 38 percent is in beds more than 28 inches thick. Coal-bed thicknesses, distribution, and correlations from Kentucky to Tennessee and from the overthrust sheet to the coal field proper are indicated.—KJE

Erickson, R. C. *See* Dryden, J. E. 02104

01771 **Ernst, W. G.** Amphiboles—Crystal chemistry, phase relations and occurrence, V. 1 *of* Minerals, rocks and inorganic materials—Monograph series of theoretical and experimental studies: New York, Springer-Verlag, 125 p., illus., tables, 1968.

No major group of rock-forming minerals is as poorly understood as the amphibole group. Although many of its species have been distinguished, mostly on a chemical basis, it is difficult to relate the geologic occurrences to physical and chemical principles. To supplement rather than repeat materials in mineralogy texts, this short volume summarizes in eight chapters some current knowledge regarding amphibole crystal chemistry, chemical variability, and experimentally determined phase relations, correlating these features with natural occurrences. It represents elaboration on notes for a series of lectures at a short course on chain silicates, sponsored by the American Geological Institute (1966).—GDC

02062 **Escher, A.; Pulvertaft, T. C. R.** The Precambrian rocks of the Upernavik Kraulshavn area (72°–74°15′ N.), West Greenland, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 11–14, 1968.

The two most striking features of Precambrian rocks of this area are the occurrence of a very large mass of uniform porphyritic granite, called Pröven Granite, in the south, and development of granulite facies gneisses around Upernavik and north of it. A biotite K–Ar age indicates that these belong in the Nagssugtoqidian mobile belt. Feldspar megacrysts in the granite resemble rapakivi feldspars. Gneisses are grouped into red-brown and gray from their weathered color. The red-brown resembles the Nukavsak Formation and may be an equivalent. Large recumbent isoclinal folds, domes, and basins characterize the area.—ESL

01936 **Esrig, Melvin I.; Gemeinhardt, John P., Jr.** Electrokinetic stabilization of an illitic clay—Closure [to discussion of paper 5235, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 6016, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 1047–1049, illus., 1968.

Discussion of the paper [ibid., v. 93, no. SM 3, p. 109–128, 1967] centers about the reason for the relationship between pH 7 and soil hardening. The writers indicated that cementation due to chemical precipitates had apparently not occurred, but did not rule it out. Another factor in this relation is that negative pore water pressures that developed were related to the zone of pH 7, which is associated with a zone of high voltage gradient; thus, the zone of pH 7 is associated with consolidating stresses resulting from electrokinetic treatment. The writers interpreted their data as strengthening due to alterations in liquid limit, and ascribed changes to ion exchange, whereas a substantial part may have resulted from increase in surface charge density accompanying rises in pH. Two figures show variation of current density and potential gradient with time.—ESL

07226 **Essene, E. J.** An occurrence of cymrite in the Franciscan Formation, California: Am. Mineralogist, v. 52, nos. 11–12, p. 1885–1890, illus., table, 1967.

Cymrite occurs with lawsonite and albitized jadeite in metagraywacke near a serpentinite body. Microprobe analysis indicates the cymrite formula is $BaAl_2Si_2O_8 \cdot H_2O$. Previous experimental data cannot be explained on the basis of this composition. Schematic analyses are presented suggesting possible phase relations of cymrite–quartz and cymrite–albite assemblages.—JSH

Eugster, H. P. *See* Rutherford, M. J. 07174

07284 **Fahrig, W. F.** Shabogamo Lake map-area, Newfoundland–Labrador and Quebec, 23 G E 1/2 [with French abs.]: Canada Geol. Survey Mem. 354, 22 p., illus., table, geol. map, 1967.

Archean, lower Proterozoic (Aphebian), and middle Proterozoic (Helekian) rocks are exposed in this area. In the northwest, Archean gneisses of hornblende granulite facies were deformed during the Kenoran orogeny. In the northeast, Aphebian sediments and volcanics were deformed during the Hudsonian orogeny and in the south and southeast by the Grenville. Helekian rocks (Sims Formation) form the cratonic cover and are undisturbed in the northeastern corner but to the south were involved in the Grenville orogeny. The metamorphosed iron-formation of the southwest has supplied a vast iron-ore industry.—GDC

07295 **Fahrig, W. F.** Geology, Shabogamo Lake (east half), Newfoundland–Quebec: Canada Geol. Survey Map 1226A (also in Mem. 354), scale 1:253,440, 1967.

02168 **Faye, G. H.** The optical absorption spectra of certain transition metal ions in muscovite, lepidolite, and fuchsite: Canadian Jour. Earth Sci., v. 5, no. 1, p. 31–38, illus., tables, 1968.

The unpolarized optical absorption spectra of the sheet silicate minerals muscovite, lepidolite, and fuchsite have been examined. The spectra, interpreted on the basis of ligand field theory, indicate that all three minerals contain Fe^{3+} and possibly Ti^{3+} in octahedral sites. In addition, muscovite is shown to contain octahedrally coordinated Fe^{2+}, lepidolite octahedral Fe^{2+} and Mn^{2+}, and fuchsite octahedral Cr^{3+}. No evidence was found for transition metals in tetrahedral sites. Some comments are made on similarity of spectra of certain transition metal ions in several

classes of minerals. This leads to the speculation that the cations Fe^{3+}, Mn^{2+} and Cr^{3+} may tend to 'mold' their immediate surroundings.—Author's abstract

01975 **Fenwick, D. K. B.; Keen, M. J.; Keen, Charlotte; Lambert, A.** Geophysical studies of the continental margin northeast of Newfoundland: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 483–500, illus., tables, 1968.

A seismic and magnetic survey was made of an area that straddles the continental margin northeast of Newfoundland from the edge of the shelf to the ocean basin of the Labrador Sea. The results bear on the question of the extension of the mobile belt of the Appalachian System in Newfoundland to the margin. The authors suggest that the continental crust is particularly magnetic, and the 'shelf-edge' anomalies especially large, because it represents the basic mobile belt of the Appalachian System terminating beneath the lower part of the continental slope. The contrast in magnetization between nonmagnetic oceanic mantle and magnetic continental crust is due to this, and perhaps also to higher temperatures in the oceanic mantle.—*from* Authors' abstract

01820 **Ferguson, Stewart A.** Geology and ore deposits of Tisdale township, District of Cochrane: Ontario Dept. Mines Geol. Rept. 58, 177 p., illus., tables, geol. maps, 1968.

The Porcupine area is the largest gold producer in Canada, and the central group of mines is in Tisdale township. Mines producing in 1965 were Hollinger, McIntyre, Dome, Preston, and Porcupine Paymaster. Gold and silver have been produced continuously since 1910, scheelite from 1940 to 1953, and copper production began in 1963. The stratigraphy, structure, and economic geology of an early Precambrian sequence of layered and intrusive rocks are discussed. It has been possible to subdivide the metabasalts in the mines, and correlate units over several miles. Subsurface charts and cross sections accompany the report. Eight of the text sections dealing with particular mines and written by staff and consulting geologists are cited separately.—ESL

Ferrians, Oscar J., Jr. *See* Miller, Thomas P. 01721

07262 **Fields, Stanley A.** The behavior of simulated lunar materials in an ultrahigh vacuum environment: Alabama Acad. Sci. Jour., v. 38, no. 2, p. 114–130, illus., tables, 1967.

In experiments with various granular materials, particle size influences the mechanical properties of simulated lunar materials; their behavior in ultrahigh vacuum differs greatly from that under ambient conditions. To determine the effect of grain size, shape, and surface contamination on adhesion properties, olivine basalt, pumice, glass spheres and crushed glass were tumbled together in a vacuum chamber kept completely oil free by a pump. The particles were thus cleaned of surface gases for better adhesion; if adequately cleaned, they will adhere to a variety of different materials. Pumice provided a heavy gas load, remained contaminated, and had very weak adhesive forces. The size range of particles selected was not necessarily that expected on the lunar surface. Degree of roughness influences strength of adhesion, as does grain roundness—the more angular, the stronger adhesion.—GDC

07206 **Fisher, D. Jerome.** Cleavelandite and the signs of the optic directions [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 289, 1967.

01926 **Fisher, David E.; Bonatti, Enrico; Joensuu, Oiva; Funkhouser, J.** Ages of Pacific deep-sea basalts, and spreading of the sea floor: Science, v. 160, no. 3832, p. 1106–1107, illus., table, 1968.

Potassium–argon age determinations from whole-rock samples of tholeiitic basalts, dredged from the crest of the East Pacific Rise and from the flanks of three seamounts at varying distances from the crest, show that the crest is younger than 1 m.y. and that age does not correlate with distance from the crest. The data, however, do not necessarily oppose the general concept of spreading of the ocean floor.—Authors' abstract

02033 **Fisher, John Joseph.** Development pattern of relict beach ridges, Outer Banks barrier chain, North Carolina [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4622B–4623B, 1968.

01744 **Fleck, Robert Joseph.** The magnitude, sequence, and style of deformation in southern Nevada and eastern California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4173B, 1968.

02119 **Fleming, Curtis C.** Geology and natural gas in Collegeport field, Matagorda County, Texas, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 359–367, illus., tables, 1968.

This anticlinal field is 3 by 6 mi and has 11,000 acres proved productive by 41 wells. Gas production currently is from 14 reservoirs in upper and middle Miocene sandstone ranging from 1,900 to 5,600 ft in depth. Four reservoirs have been depleted. Oil production is from a small, isolated reservoir at the east end of the field. Most of the reservoirs are sandstone lenses limited to the field area. The field is fully developed in the Miocene gas sands. Current annual gas production is 17.5 billion cu ft. Field reserves are about 60 percent depleted. Gas mixtures differ little according to depth and areal location. Methane content averages between 98 and 99 percent, and heating values average about 1,000 BTU per cubic foot of gas.—*from* Author's abstract

01775 **Flower, Rousseau H.** The first great expansion of the actinoceroids: New Mexico Bur. Mines and Mineral Resources Mem. 19, p. 1–16, 57–86, 118–120, illus., 1968.

The family Wutinoceratidae is developed in the Whiterock Stage of North America, and members of the family in other regions may indicate Whiterock equivalence of the containing beds. The Wutinoceratidae are discussed; new material, largely from the Whiterock of Nevada and Utah and from the Table Head of Newfoundland, yielded the several new species here described. Notes on occurrence and stratigraphy are included as well as a discussion of the evolution of the Actinoceratida in the Ordovician and some remarks upon the classification of the group. The thesis that the actinoceroids should be elevated in rank equivalent to the Nautiloidea from which they were removed is rejected. Fine structures of septa and the connecting ring are described for *Adamsoceras* cf. *isabelae*.—Author's abstract

01778 **Flower, Rousseau H.** Some additional Whiterock cephalopods: New Mexico Bur. Mines and Mineral Resources Mem. 19, p. 17–55, 66–120, illus., 1968.

Here are described and illustrated nautiloids from the Whiterock Stage, mainly of Nevada and Utah comprising 15 genera and 27 species. The Whiterock cephalopods are summarized, drawing upon some material not yet described. They tend to support equivalence of the Utah–Nevada region, the Joins and Oil Creek of Oklahoma, and the lower Table Head of Newfoundland as a pre–Marmor interval. Cephalopod evidence is so far wanting for the higher beds of the Antelope Valley limestone of Nevada.—Author's abstract

01777 **Follett, W. I.** Fish remains from two submerged deposits in Tomales Bay, Marin County, California: California Acad. Sci. Occasional Paper 67, 8 p., illus., 1968.

Fish remains representing six species, referable to six genera and five families, were taken from test borings of submerged deposits in Tomales Bay. Specimens from Test Boring 1 were collected 10.7 to 12.1 feet below mean low water in sandy material mixed with charcoal and midden shell. A C–14 date of 340±130 yr B.P. has been obtained from some of the associated material. Specimens from Test Boring 2 were collected 21.0 to 24.5 feet below mean low water; associated material yielded a C–14 date of 1700±190 yr. Specimens include remains of sharks, rays, herrings, sardines, hakes, and flounders. With the exception of the hake, all species in the midden collection were presumably obtained by aborigines in comparatively shallow water.—MST

02109 **Folsom, L. W.** Economic aspects of Uinta basin gas development, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 199–208, illus., table, 1968.

Most commercial gas production in the Uinta basin is from stratigraphic traps in the nonmarine Wasatch Formation. Minor production has been found in the Uinta Formation, the Mesaverde Group, and the Dakota and Morrison Formations. Natural gas reserves are estimated to be more than one trillion cu feet and projected development and exploratory drilling should prove reserves equal to or even exceeding the most optimistic estimates. Various economic aspects are outlined.—*from* Author's abstract

Foote, Leonard J. *See* Meighan, Clement W. 01925

Foster, W. R. *See* Lin, H. C. 07198

Fowler, Gerald Allan. *See* Pytkowicz, Ricardo Marcos. 07173

Foxworthy, B. L. *See* Cohen, Philip. 01795

Franke, O. L. *See* Cohen, Philip. 01795

01849 **Freeze, R. Allan; Witherspoon, P. A.** Theoretical analysis of regional ground water flow—[Pt.] 3, Quantitative interpretations: Water Resources Research, v. 4, no. 3, p. 581–590, illus., 1968.

The natural basin yield of a ground water basin can be calculated from a quantitative analysis of the flow net obtained from a digital computer solution to a numerical mathematical model of the basin. The natural basin yield is a unique property of the basin and can be considered as a measure of the ground water recharge to the basin and a conservative estimate of the safe yield. Rates of ground water recharge and discharge vary from place to place throughout the areal extent of a basin; a quantitative analysis can be used to determine the positions of concentration. Quantitative interpretation of ground water flow nets can play an important role in the calculation of basin-wide water balances due to the interrelationships between ground water recharge and infiltration at one end of the flow system and ground water discharge, evapotranspiration, and stream baseflow at the other.—Authors' abstract

01728 **Frey, Richard Paul.** Distribution and genesis of dolomite in Kinderhook rocks of Missouri [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3750B, 1968.

Friedrich, G. *See* Boyle, R. W. 02055

07207 **Frondel, C.; Ito, J.** Crystal chemistry and geochemistry of scandium [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 289, 1967.

Frueh, A. J., Jr. *See* Toman, K. 02060

Frueh, A. J., Jr. *See* Toman, K. 02061

02034 **Frye, Charles Isaac.** The Hell Creek Formation in North Dakota [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4623B, 1968.

07208 **Fuchs, L. H.** Stanfieldite, a new phosphate mineral in stony-iron meteorites [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 289–290, 1967.

01972 **Fullagar, Paul D.; Bottino, Michael L.** Radiometric age of the volcanics at Arisaig, Nova Scotia, and the Ordovician–Silurian boundary: Canadian Jour. Earth Sci., v. 5, no. 2, p. 311–317, illus., tables, 1968.

Volcanics from the Arisaig–Antigonish district of northeastern Nova Scotia underlie fossiliferous Lower Silurian (Lower Llandovery) sediments. The minimum geologic age of the volcanics is Early Silurian, and the maximum geologic age probably is

post–Early Ordovician. Twelve whole–rock samples of the volcanics were analyzed for rubidium, strontium, and strontium isotopic composition. The best estimate of the age of these twelve samples is 430±15 m.y.; this is a maximum age or close to a maximum age for the Ordovician–Silurian boundary. This age plus the authors' results for the Silurian–Devonian boundary indicate that the Silurian Period in northeastern North America may have been shorter than generally has been estimated. Additional Silurian–age volcanics are being analyzed.—Authors' abstract

Funkhouser, J. *See* Fisher, David E. 01926

01745 **Gaskarth, Joseph William.** Petrogenesis of Precambrian rocks in the Hanson Lake area, east–central Saskatchewan [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4173B–4174B, 1968.

02094 **Gates, George O.; Grantz, Arthur; Patton, W. W., Jr.** Geology and natural gas and oil resources of Alaska, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 3–48, illus., table, 1968.

A very brief discussion of the geology of Alaska is followed by a review of the possible hydrocarbon–containing areas. The Alaska Peninsula–Cook Inlet area consists of Mesozoic and Cenozoic rocks with gas occurring in the latter in the Cook Inlet area. The Bristol Bay Tertiary Province is underlain by marine and nonmarine rocks in which petroleum or gas are unknown. Oil seeps occur in the Pacific–margin Tertiary province, but no production is known. The Bering Sea shelf is a potential resource area as Mesozoic and possibly Tertiary rocks are present. Most of the Arctic Slope province, save for the southern Brooks Range, the Yukon–Koyukuk province locally, and the Yukon–Porcupine province largely, are potential resource areas also.—*from* Authors' abstract

Gay, T. E. *See* Macdonald, G. A. 02053

Geldart, L. P. *See* Sharma, Bijon. 02013

Gemeinhardt, John P., Jr. *See* Esrig, Melvin I. 01936

01927 **Gentry, Robert V.** Fossil alpha–recoil analysis of certain variant radioactive halos: Science, v. 160, no. 3833, p. 1228–1230, illus., 1968.

The distribution of alpha–radioactivity in the vicinity of uranium and of certain variant radioactive halos in biotite was investigated by the fossil alpha–recoil method. Within the limits of the methods it was possible to confirm a previously proposed hydrothermal mechanism for the origin of certain variant halo types due to polonium isotopes.—*from* Author's abstract

07209 **Giese, R. F., Jr.** The crystal structure of kernite $Na_2B_4O_6(OH)_2 \cdot 3H_2O$ [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 290, 1967.

Giger, H. *See* Amstutz, G. C. 07213

02008 **Giles, Ben F.** Pneumatic acoustic energy source: Geophys. Prosp. [Netherlands], v. 16, no. 1, p. 21–53, illus., 1968.

Recent developments in nondynamite offshore marine acoustic energy sources include adaptation of the Vibroseis and Dinoseis from land to marine units. The Seismic Underwater Explorer system is a thermodynamic nondynamite source which gives penetration to more than 4 sec in areas with Gulf of Mexico type geology: a pneumatic source, the air gun, has been used in the United States since 1966: it is versatile and can be expanded to provide additional energy as necessary to obtain the penetration desired. Tests using systems consisting of 8 to 23 air guns show penetration in excess of 5 sec in many areas. The improvement in record quality as a result of advanced digital processing with nondynamite sources is comparable to that obtained with dynamite sources. Nondynamite sources make additional improvements possible where high source multiplicity is advantageous.—KAS

01729 **Giles, David L.** A petrochemical study of compositionally zoned ash-flow tuffs [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3750B-3751B, 1968.

Giles, David L. *See* Noble, Donald C. 01931

01915 **Gillerman, Elliot.** Uranium mineralization in the Burro Mountains, New Mexico: Econ. Geology, v. 63, no. 3, p. 239-246, illus., table, geol. map, 1968.

In the White Signal district, secondary uranium phosphates occur in the oxidized portions of gold-pyrite-quartz veins and in adjacent fractures. Nature of primary mineralization is unknown. Concentrations are believed to result from oxidation of veins and fixation of uranium by phosphate from neighboring diabase dikes. In the Bullard Peak district, uraninite is associated with nickel and cobalt arsenides and sulfarsenides toward the margins of veins that have native silver in their central portions. The uraninite may represent the last phase of silver and base-metal mineralization or be related fluorspar and gold mineralization of nearby areas. Its source is probably a nearby Laramide monzonitic intrusion.—WSW

01940 **Gilliland, J. A.** Digitizing, storing and recovering observation-well hydrographs: Jour. Hydrology, v. 6, no. 2, p. 143-167, illus., tables, 1968.

Important factors in digital recording and recovery of ground-water hydrographs are: efficiency of recording, record losses, and accuracy. There are two basic methods of digital recording: fixed-time and fixed-interval; five different methods based on combinations of these two are considered. In general, accuracy improves for all methods with increasing number of records, but as efficiency deteriorates, probability of losses increases. If rate of movement of the ground-water level is known, and digitizing intervals are given, then the most suitable method of recording for any particular application can be selected. In the Interior Plains of Canada, rate of movement is simply related to the annual range of water levels. Fixed-interval recording offers some worthwhile gains compared with fixed-time recording, because of limitations in accuracy of measurement of water levels.—*from* Author's abstract

01772 **Gilluly, James; Waters, Aaron C.; Woodford, A. O.** Principles of geology (3d edition): San Francisco, Calif., and London, W. H. Freeman and Co., 687 p., illus., tables, revised 1968; originally published 1951.

The textbook is divided into 22 chapters covering: the science, geology; minerals and matter; records of the rocks; weathering and soils; erosion; geologic maps; fossils, strata, and time; movements of the Earth's crust; records of earth movements; geodesy, isostasy, and strength; downslope movements of soil and rock; stream erosion and deposition; glaciers and glaciation; ground water; deserts and wind work; oceans; sedimentary rocks and environments of deposition; igneous activity and metamorphism; earthquakes and Earth's interior; mountains; mineral resources; and speculations on the origin of the Earth and of life. Appendixes cover maps and mapping, mineral and rock identification, chemical data, and fossils. The last chapter and last appendix are new with this edition.—ESL

07195 **Girault, J.** Fluid contents of apatites from the Oka complex, Quebec, and possible genetic implications [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 290-291, 1967.

Gittins, J. *See* Ingamells, C. O. 07220

Glanzman, R. K. *See* Coffin, D. L. 02086

Glass, D. J. *See* Hancock, W. P. 02139

Glasser, John D. *See* Cleaves, E. T. 01793

01730 **Glover, Lynn, 3d.** Geology of the Coamo area, Puerto Rico, with comments on greater Antillean volcanic arc-trench phenomena [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3751B, 1968.

07254 **Goebel, Edwin D.** Cowley problem, Mississippian of southcentral Kansas [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 289, 1967.

01863 **Gold, David P.** Natural and synthetic diamonds and the North American outlook: Earth and Mineral Sci., v. 37, no. 5, p. 37–43, illus., tables, 1968.

The properties of diamonds are described, and their distribution discussed. Their primary home is in kimberlite pipes or dikes, but alluvial diamonds represent over 90 percent of the world's production. Finds in North America are rare, the more important being those in glacial drift in the Great Lakes area because they indicate a source area in the Shield. The search for diamonds entails a search for kimberlite; the varieties of kimberlite, tectonic aspects of their occurrences, and the surface expression and size are described. The best exploration technique in a glaciated area is a combination of stream sediment and esker sampling. Geophysical methods are useful only when the target area has been delineated. Some guides to selecting a target area are given. Phase relations of carbon are shown in a diagram and the regions discussed.—ESL

Goldstein, M. *See* Strangway, David W. 01949

01731 **Goll, Robert Miles.** Classification and phylogeny of Cenozoic Trissocyclidae (Radiolaria) in the Pacific and Caribbean Basins [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3751B, 1968.

01846 **Good, Donald L.** The Burlington crinoids: Earth Sci., v. 21, no. 4, p. 161–164, illus., 1968.

Numerous species of Burlington crinoids [Mississippian] can be collected from limestone exposures of west-central Illinois and southeastern Iowa. A general discussion of crinoids and stratigraphy is reviewed. Suggested extraction, relative to the quality of the stone, is indicated and specific collecting sites are described.—Author's abstract

01710 **Goode, Harry D.** Summaries—Keys to better organization in geologic reports: Mtn. Geologist, v. 5, no. 2, p. 83–86, 1968.

A well organized geologic report contains summaries from its title to its conclusions. The informative title summarizes the subject matter, the abstract summarizes all major conclusions and condenses the basic information, the introduction delimits the scope of the paper and discusses in condensed form the methods used to reach the reported results, each section of the body of the report summarizes in its introductory sentences or paragraphs the essential features that are discussed in more detail within the section, and, finally, if the report contains formalized conclusions, these summarize the more detailed information that is in the body of the report. The writer who recognizes the value of properly placed summaries will be able to produce more useful reports.—Author's abstract

Gordon, Bernard B. *See* Jansen, Robert B. 01937

01952 **Gordon, R. B.; Davis, L. A.** Velocity and attenuation of seismic waves in imperfectly elastic rock: Jour. Geophys. Research, v. 73, no. 12, p. 3917–3935, illus., table, 1968.

The mechanical properties of crystalline rock have been studied in the laboratory as a function of temperature and pressure. The inelasticity observed arises at interfaces in the rock and is insensitive to temperature but highly pressure dependent. The internal friction is accompanied by a large modulus defect; both are independent of frequency and strain amplitude throughout a wide range. A fluid phase in the rock does not in itself significantly increase the internal friction in the range of frequencies of seismic waves, but a small amount of intergranular fluid can make interface inelasticity persist in the presence of a large confining pressure. Interface inelasticity at substantial depths in the earth, results in low seismic velocities and low Q. The low velocity zones in certain areas are interpreted as arising from the pressure of a fluid phase.—*from* Authors' abstract

01904 **Gorsline, Donn S.; Drake, David E.; Barnes, Peter W.** Holocene sedimentation in Tanner Basin, California continental borderland: Geol. Soc. America Bull., v. 79, no. 6, p. 659–674, illus., table, 1968.

Piston cores from Tanner Basin, on the California Continental Borderland, record evidence for hemipelagic "turbidite" sedimentation that is in accord with Curray's model for a Holocene sea-level rise. Decreasing amounts of terrigenous sediments were contributed as rising sea level flooded exposed banks and shelves and reduced stream gradients on land. Radiocarbon and paleontologic dates provide markers for computation of sedimentation rates which show that contributions of biogenic and terrigenous fines have been constant for the past 7,500 years, reflecting a greatly reduced rate of sea-level rise. Carbonate contributions, primarily from foraminifera have been nearly constant over the past 12,000 years. This reflects little change in the oceanographic circulation. The Holocene record is continuous over the entire basin floor, although variable in absolute magnitude; the thickness of hemipelagic material is related to topography.—*from* Authors' abstract

07251 **Gould, Howard R.** Sedimentary facies and their importance in oil finding [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 286, 1967.

01746 **Gould, Stephen Jay.** Pleistocene and Recent history of the subgenus *Poecilozonites (Poecilozonites)* (Gastropoda: Pulmonata) in Bermuda—An evolutionary microcosm [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4174B–4175B, 1968.

01954 **Gow, Anthony J.** Electrolytic conductivity of snow and glacier ice from Antarctica and Greenland: Jour. Geophys. Research, v. 73, no. 12, p. 3643–3649, illus., tables, 1968.

Conductivity measurements have been made on snow and ice samples from pits and drill holes at a number of localities in Antarctica and Greenland. Conductivities of the order of 1–2 μmhos per cm were recorded only at the inland sites. Data from deep cores representing more than 1900 yr of continuous snow accumulation at Byrd station, Antarctica, and more than 400 yr of deposition at Inge Lehmann, Greenland, showed no significant variations of conductivity with time. Measurements of freshly precipitated snow from a single coastal location in McMurdo Sound also yielded relatively low conductivities of the order of 3–4 μmhos per cm. The substantial increase observed in the conductivity of core samples from near the surface of the Ross Ice Shelf at Little America V can probably be attributed to wind-borne salts of marine origin that accumulated on the surface after the snow was deposited.—*from* Author's abstract

07308 **Graf, E. R.** The Prehistoric earth as a ten CPS resonator [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 4, p. 381, 1967.

01969 **Graham, R. A. F.** Effects of diabase dike intrusion on sulfide minerals at Manitouwadge, Ontario: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 545–547, illus., 1968.

A diabase dike intruding a Cu–Zn massive sulfide orebody has caused a migration of copper and sulfur in the orebody towards the dike, but neither element penetrated the glassy chilled margins of the dike. This resulted in the development of a chalcopyrite-rich zone along the contact and a much broader zone of sulfur enrichment within which pyrrhotite was firstly sulfur enriched and then converted to pyrite and where the iron content of sphalerite was decreased.—Author's abstract

Grant, D. R. *See* Prest, V. K. 01827

Grantz, Arthur. *See* Gates, George O. 02094

02143 **Gras, Victor B.** Church Buttes gas field, Wyoming, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 798–802, illus., table, 1968.

The Church Buttes gas field of southwestern Wyoming is on a large anticline, with faint surface expression, which was discovered by seismic exploration. An Eocene-Jurassic section 14,646 ft thick has been penetrated, but oil shows have not been found. Gas is produced from the Dakota Formation.—Author's abstract

Gray, N. H. *See* Kumarapeli, P. S. 01958

07319 **Green, Melvin G.** Artificial recharge to the Edwards Limestone aquifer in south Texas [with French abs.], *in* Hydrology of fractured rocks Dubrovnik Symposium, 1965, Proc., V. 2: Internat. Assoc. Sci. Hydrology Pub. 74, p. 465–481, illus., 1967.

The Edwards Limestone aquifer in south-central Texas is the area's prime natural water resource for an estimated 850,000 people. Recharge, furnished by streams which flow southerly across the Edwards in the Balcones fault zone, averages 423,200 acre-feet annually, but is relieved by discharge from springs located down gradient. Balance between recharge and discharge has been disrupted by some 4,000 wells drilled since the late 1800's. A proposed plan of providing recharge as part of plans for flood control and water conservation by construction of five dams, would provide an additional 153,000 acre-feet of water annually, thus meeting demands to approximately the year 2000.—*from* Author's abstract

Green, R. *See* Hales, A. L. 01946

01870 **Greene, Robert C.** Petrography and petrology of volcanic rocks in the Mount Jefferson area, High Cascade Range, Oregon: U.S. Geol. Survey Bull. 1251-G, p. G1–G48, illus., tables, 1968.

High Cascade volcanic rocks in the Mount Jefferson area are grouped and discussed according to the silica content as determined from fused beads. The dominant type of rock is andesite with 52–55 percent SiO_2. The peaks, Mount Jefferson and Three Fingered Jack, consist of silicic andesite and interbedded cinder agglutinate. Dacite and rhyodacite are found at high elevations north of Mount Jefferson. Recent intracanyon flows are andesite similar to the most common composition of the older rocks. Petrologic diagrams based on eight chemically analyzed specimens show the Pliocene and Pleistocene lavas to be a differentiated sequence. Their chemistry is compared with other suites from the Cascades and elsewhere. The rocks are high in alumina, low in potassium, and probably crystallized at nearly constant oxygen pressure.—RCG

07238 **Greenwood, H. J.** Wollastonite—Stability in H_2O–CO_2 mixtures and occurrence in a contact-metamorphic aureole near Salmo, British Columbia, Canada: Am. Mineralogist, v. 52, nos. 11–12, p. 1669–1680, illus., tables, 1967.

The reaction of calcite and quartz to form wollastonite has been determined in supercritical mixtures of H_2O and CO_2 at pressures of 1000 and 2000 bars. CO_2-H_2O mixtures do not depart greatly from ideality below 2000 bars and above 500°C. An 'isograd' can be drawn between rocks containing calcite + quartz and rocks containing wollastonite. This boundary roughly parallels an intrusive contact, consistent with heat flow from an irregular intrusion. Local divergence can be explained by variations in the proportion of CO_2 and H_2O.—JSH

01897 **Greenwood, Robert.** Syngenetic sulfides in sediments—Additional field evidence: Econ. Geology, v. 63, no. 2, p. 188–189, 1968.

Chalcopyrite, with minor galena and pyrite, makes up 0.1 percent of fossiliferous concretions in siltstone of the Silurian Eastport Shale in Maine. Equigranular epidote and quartz are major constituents of the concretions, and chlorite and calcite are minor. There is no evidence for epigenetic mineralization. Decomposition of organic matter is considered to be the precipitating agent.—WSW

07237 **Greenwood, Robert.** Thermal behavior of SiO_2–X and its relation to the natural silica minerals: Am. Mineralogist, v. 52, nos. 11–12, p. 1662–1668, tables, 1967.

SiO_2–X, a silica polymorph known only since 1964, exhibits both ordered and disordered modifications. Two of the principal lattice spacings, 3.38 and 1.84 A

are close to those of quartz, but its refractive index of 1.484 and its behavior on heating favor affinities with cristobalite. Its lattice spacing at 17.3–18.0 A is unique among silica polymorphs. Possibilities for natural occurrences exist in near-surface deposits.—Author's abstract

01768 **Griffis, A. T.** McIntyre Porcupine Mines, Limited, *in* Geology and ore deposits of Tisdale township: Ontario Dept. Mines Geol. Rept. 58, p. 122–130, 1968.

The mine started production in 1912 and through 1960 had totalled 8,612,653 oz of gold and 1,882,176 oz of silver. Copper has been discovered recently. Rocks consist of Keewatin lavas intruded by porphyry, albitite, and diabase. The lavas have been classified according to the presence or absence of flow structures. Two major foldings took place: in the first, dragfolds were overturned to the south, and in the second, stress was in almost the opposite direction. Ore occurrence is related in the major sense to the Hollinger anticline, and there is a general distribution of ore and alteration around the Pearl Lake Porphyry, which suggests a genetic relationship. In detail, ore is controlled in part by folding, by flow contacts, and by fracturing, the whole resulting in a complex vein system about the porphyry, extending to at least 7,800 feet below the surface.—ESL

01912 **Groff, S. L.** Montana's place in the nation's coal energy picture, *in* Technology and use of lignite—Bureau of Mines-University of North Dakota Symposium, Grand Forks, N. Dak., 1967, Proc.: U.S. Bur. Mines Inf. Circ. 8376, p. 40–56, illus., tables, 1968.

Between 8 and 12 billion tons of lignite and sub-bituminous coal in the part of Montana underlain by the Fort Union Formation are strippable. Availability of water and other factors affecting the significance of this resource are reviewed.—APB

07154 **Gross, E. B.** Phosphate-sulfate mineralization at the White Mountain andalusite deposit, Mono County, California [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 291, 1967.

02088 **Gwinn, Vinton E.** Divergence between dip direction of cross-strata and enclosing cross-strata set boundaries—A characteristic of alluvial point-bar sands [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 530, 1968.

01690 **Hackett, James E.** Geologic factors in community development at Naperville, Illinois: Illinois Geol. Survey Environmental Geology Notes 22, 16 p., illus., 1968.

The geology of the Naperville area—ground-water resources, stream flow, and extent of flooding—are related to various aspects of community development, such as facilities for water, sewage disposal, and storm-water drainage control. The glaciated land surface is widely underlain by pebbly clay, which covers permeable deposits of sand and gravel, and sedimentary bedrock that extends to granite basement 4,000 feet below. The uppermost bedrock, a not very permeable but randomly cracked dolomite, is water-bearing and is crushed for aggregate. Underlying sandstones—St. Peter, Ironton-Galesville, and Mt. Simon—are significant potential sources of water. Because of low relief, gentle slopes, and small surface drainage, flooding occurs on a limited scale and ponding is widely distributed. Water pollution is a special problem. Planning policies are summarized.—GDC

07187 **Haefeli, R.** Some results of the International Glaciological Expedition to Greenland 1957–1960, concerning the rheological behaviour of snow and ice, *in* Physics of snow and ice—Internat. Conf. on Low Temperature Science, Sapporo, Japan, 1966, Proc., V. 1, Pt. 2: Sapporo, Japan, Hokkaido University, p. 983–991, illus., 1967.

A very brief summary is given of results obtained by this expedition at the wintering station of Jarl-Joset from studies of the plastic deformation of firn and ice under its own weight and under external forces. Tests included measurements of ramm hardness as a function of depth, shear strength of polar névé, near-surface creep, deformation of spherical hollows at 20 and 40 m depths, vertical strain rate between

0 and 20 m depth, viscosity and compressibility of névé, rheology of inland ice along an E–W profile, age of ice, strain rate along the E–W profile, and a model test of two-dimensional flow in a viscous medium.—VSN

07234 **Hafner, Stefan; Raymond, Michael.** The nuclear quadrupole coupling tensors of Al^{27} in kyanite: Am. Mineralogist, v. 52, nos. 11–12, p. 1632–1642, illus., tables, 1967.

The nuclear electric quadrupole coupling tensors of Al–27 at the four nonequivalent aluminum sites in kyanite have been determined by use of nuclear magnetic resonance. The eigenvalues and the asymmetry parameters η are: 10.0 MHz, 9.4 MHz, 6.5 Hz, 3.7 MHz, and 0.27, 0.38, 0.59, 0.89, respectively. The magnitudes of two of the coupling tensors are the greatest found to date in any aluminum compound. Each of the four tensors indicates a strong electronic polarization of the aluminum atoms approximately parallel to b.—*from* Authors' abstract

01883 **Hagni, Richard D.** Titanium occurrence and distribution in the magnetite–hematite deposit at Benson Mines, New York: Econ. Geology, v. 63, no. 2, p. 151–155, illus., 1968.

The ores have a rather uniform titania content, averaging 0.77 percent. Titanium occurs mainly in solid solution in hematite (0.15 to 8 percent) with lesser amounts as ilmenite, anatase, rutile, sphene, leucoxene, and biotite. Magnetite contains 0.1–0.2 percent. High-grade hematite ores generally have all titania in the hematite. Ilmenite and finally anatase increase in abundance as grade decreases, and also as the magnetite–hematite ratio increases at the boundaries between hematite and magnetite ore. Textures suggest that uniformly distributed titania in the host-rock was preferentially taken up by hematite, and that greatest subsequent exsolution took place in those rocks with least hematite.—WSW

02113 **Halbouty, Michel T.** Economic and geologic aspects of search for gas in Texas Gulf Coast, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 271–283, illus., tables, 1968.

Texas Railroad Commission Districts 2, 3, and 4, have the largest reserves, produce the greatest quantity of gas yearly, have the largest number of gas fields, and contain the greatest number of trillion-cubic-feet gas fields than any other part of the United States. The major Gulf Coast exploration has been in Miocene–Oligocene sandstones and in the lower Eocene and Cretaceous. Pre-Tertiary zones appear very promising, but more economic incentive is necessary. Results of offshore exploration have been discouraging, although reasonably good prospects for gas discovery offshore still exist; economic incentive is needed here also.—*from* Author's abstract

02115 **Halbouty, Michel T.** Old Ocean field, Brazoria and Matagorda Counties, Texas, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 295–305, illus., table, 1968.

Old Ocean field is on a large asymmetrical dome which is probably the result of deep-seated salt movement. Accumulation and entrapment are anticlinal. Most of the production is from four reservoirs, all Frio in age. Two are characterized by huge gas caps with oil rims; the other two are primarily gas and condensate, and reservoirs. Original reserves are estimated to have been 4,466,000 million cu feet of gas, over 198 million bbls of condegate, and over 276 million bbls of oil. Deeper possibilities, down to 15,000 feet, have been explored by one dry hole.—*from* Author's abstract

02120 **Halbouty, Michel T.; Hardin, George C., Jr.; Barber, Thomas D.** Port Acres and Port Arthur gas-condensate fields, Jefferson County, Texas, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 368–375, illus., table, 1968.

The Port Arthur field is in an anticlinal closure and the adjacent Port Acres field is in a stratigraphic trap. The two are separated by a large normal fault, which

was contemporaneous with deposition, and structural configuration probably is a result of deep-seated salt movement. As much as 700 feet of displacement is evident along the fault. Gas in the Port Acres field is trapped because of the lensing out of the upper sandstone unit in the lower Hackberry (Oligocene) against a southeast-plunging structural nose. Gas in the Port Arthur field is trapped because of a northeast trending anticlinal closure dipping northwest into a fault in lower Hackberry sandstone. The sandstones were deposited as a seaward-building delta.—*from* Authors' abstract

01946 **Hales, A. L.; Cleary, J. R.; Doyle, H. A.; Green, R.; Roberts, J.** P-wave station anomalies and the structure of the upper mantle: Jour. Geophys. Research, v. 73, no. 12, p. 3885–3896, illus., table, 1968.

Regional differences in seismic traveltimes at teleseismic distances have been estimated by various authors, and the agreement between them is sufficient to establish that the effects are real. Many data exist about these teleseismic anomalies and the corresponding P_n anomalies in the United States. Comparison of these values with model studies of the variation of P station anomalies with distance indicates that the major source of the anomalies is in the upper mantle. Furthermore, the variation in the anomalies between the western and eastern United States can be explained satisfactorily by a change in the thickness of the upper mantle low-velocity layer. The possibility that the temperature changes associated with the development of a thicker low-velocity layer were responsible for vertical movements of the crust is discussed.—Authors' abstract

02015 **Hales, A. L.; Helsley, C. E.; Dowling, J. J.; Nation, J. B.** The East Coast onshore-offshore experiment—[Pt.] 1, The first arrival phases: Seismol. Soc. America Bull., v. 58, no. 3, p. 757–819, illus., tables, 1968.

A cooperative seismic crustal structure experiment involving 11 participating institutions was conducted off the East Coast of the United States during the summer of 1965. Underwater shots varying in size from 20 lb to 10 tons of explosive were detonated along four lines—two off North Carolina and two off Virginia. In each area one line was approximately normal to the continental margin and the other to the margin near the outer edge of the continental shelf. Preliminary analyses of the data indicate a general crustal structure varying from 0.5 km of sediment overlying 30.4 km of basement for the southern profiles of 1.6 km of sediment above 8.3 km of low velocity basement overlying about 16.3 km of high velocity basement in the northern area. Shot positions, shot instants, and first arrival times are summarized in tables.—*from* Authors' abstract

01907 **Hall, H. T.** Synthesis of two new silver sulfosalts: Econ. Geology, v. 63, no. 3, p. 289–291, illus., table, 1968.

The compounds Ag_7AsS_6 and Ag_7SbS_6 are apparently stoichiometric in the presence of their respective constituent elements, and require high sulfur fugacity for stability. X-ray diffraction analysis of compositions intermediate between the two indicate a continuous solid solution series. Up to 12.5 weight percent Cu can substitute for Ag in the arsenic compound at 340°C, and 3.5 percent Cr in the antimony compound. The unit cell edges are 10.48A and 10.60A, respectively, for X-ray data indexed on the basis of a primitive isometric unit cell. Two localities in Colorado may provide natural occurrences.—WSW

07246 **Ham, William E.** Reefs and stromatolites [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 284, 1967.

02106 **Hamilton, S. V.** Wilmington Field, Los Angeles County, California, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 164–168, illus., 1968.

The Wilmington field is on a well-developed, highly faulted anticline which trends northwest-southeast. Five major north-south-trending faults divide the field into six structural blocks; all are normal, and all have the major displacement near the axis of the anticline. Jurassic schist is the basement rock which is overlain by about 4,000 feet of Miocene, 2,000 to 2,500 feet of Pliocene, and 1,000 feet of sand and

gravel of Pleistocene to Recent age. Unconformities occur within the Pliocene as well as at the base of the Miocene. Upward migration is controlled by impervious beds; lateral migration is controlled by the faults. Oil comes from all of the rocks but the Pleistocene. The field produces wet gas but is essentially an oil field; gas reserves are estimated at over 195 billion cu feet.—*from* Author's abstract

07199 **Han, Tsu-Ming.** Ore mineral relations in the Cuyuna sulfide deposit, Minnesota [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 291–292, 1967.

02139 **Hancock, W. P.; Glass, D. J.** Medicine Hat–Hatton gas field, Alberta and Saskatchewan, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 731–735, illus., 1968.

Estimated initial recoverable reserves of 1,964 billion cu ft and a total productive area of 775,000 acres make Medicine Hat–Hatton the largest gas field in volume and areal extent in western Canada. It also is among the shallowest producing areas, with an average depth to the productive zone of 1,500 ft. Gas is obtained from the Medicine Hat Sandstone, a thin, very lenticular, argillaceous sandstone member of the Upper Cretaceous Colorado Group. This sandstone is limited to a fairly small area in southeastern Alberta and an adjoining part of Saskatchewan. Gas is contained in the more porous and permeable parts of this sandstone body by what was originally an updip pinchout. The accumulation probably occurred before the final uplift of the Sweetgrass arch.—*from* Authors' abstract

Hansen, John. *See* Lövborg, Leif. 01860

07300 **Hansen, John P.** The U.S. Bureau of Mines—Its organization and research program [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 3, p. 262–263, 1967.

01801 **Hanshaw, Penelope M.** Bedrock geologic map of the Meriden quadrangle, New Haven, Hartford and Middlesex Counties, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-738, scale 1:24,000, sections, separate text, 1968.

Rocks in the Meriden quadrangle are part of the Late Triassic Newark Group; surficial deposits, mostly glacial in origin, cover more than 98 percent of the area. Four red continental sedimentary formations intercalated with three basaltic lava flows are broken by a series of northeast-trending, west-dipping, high-angle normal faults. Formations described are: New Haven Arkose, Talcott Basalt, Shuttle Meadow Formation, Holyoke Basalt, East Berlin Formation, Hampden Basalt, Portland Arkose, and diabase dikes. The only rock now being exploited commercially is the Holyoke Basalt which provides excellent crushed stone.—MCM

02122 **Hardin, Frank R.** Effects of contemporaneous structural movement on sedimentation at Thornwell field, Jefferson Davis and Cameron Parishes, Louisiana, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 582–593, illus., tables, 1968.

The productive stratigraphic section consists of alternating sandstone and shale; its thickness more than doubles from northwest to southeast across Thornwell field and takes place across a series of contemporaneous faults. Prior to *Camerina* time faults were not in existence. Thornwell is a domal structure with a complex fault pattern consisting of a large normal, northeast-trending fault which branches into radial faults toward the northeast. The structurally highest block is the northwestern block. Toward the southeast, each block is successively lower around the structure in a clockwise direction. Production is in at least ten reservoirs.—*from* Author's abstract

02114 **Hardin, George C., Jr.; Clark, W. Kenley.** Gas resources of Eocene producing trend, Upper Gulf Coast of Texas, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 284–294, illus., tables, 1968.

The most important gas and oil reservoirs are sandstone of the Eocene Wilcox and Yegua Formations although some gas and oil have come from other units. The Wilcox is predominantly nonmarine; downdip, interfingering marine and nonmarine sediments grade into a predominantly marine sequence. Sandstone bodies are regionally lenticular, and permeability and porosity decrease downdip. The Yegua is predominantly marine and grades into marine shale downdip. Porosity is generally good, but permeability is varied. Yegua sandstone bodies are fairly persistent and can be correlated over wide areas. The regional structure is a southeast-dipping monocline, interrupted by small faults and salt domes. Gas comes from both formations in several types of traps.—*from* Authors' abstract

Hardin, George C., Jr. *See* Halbouty, Michel T. 02120

02097 **Harding, Tod P.** Perkins Lake gas field, Butte County, California, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 76–78, illus., 1968.

Gas occurs in a sandstone trap localized on an anticline in lower Eocene rocks. The Eocene rocks appear to overlie a regional unconformity on Upper Cretaceous rocks, and the topography of this unconformity is such that it appears that the gas-bearing Eocene rocks were deposited in an erosional trough, or gorge; the gas occurs in the basal member of the filling material. From 1955 to 1966, the total recovery was over 22 billion cubic feet and estimated recovery is over 35 billion cubic feet.—HRC

02170 **Harper, C. T.** Isotopic ages from the Appalachians and their tectonic significance: Canadian Jour. Earth Sci., v. 5, no. 1, p. 49–59, illus., tables, 1968.

Field relations and previously reported isotopic ages provided evidence for a pattern of lower Paleozoic tectogenesis, indicating intrusion of ultramafic and mafic rocks and major episodes of metamorphic recrystallization completed before the end of the Silurian. New K–Ar ages in the northern Appalachians confirm this pattern. Whole-rock ages of Taconic slates indicate that metamorphism occurred during Middle to Late Ordovician. Mica ages of schists along the Green Mtn. anticlinorium are indicative of postmetamorphic uplift and cooling during Silurian and Early Devonian. Ages of a variety of metamorphic rocks in eastern Vermont (345±7 m.y.) indicate renewed uplift and rapid cooling in Late Devonian time. Comparison of Appalachian age data with that from British Caledonian fold belts indicates a synchronous sequence of lower Paleozoic tectonic and magmatic activity, lasting about 100 m.y., in both areas.—*from* Author's abstract

Harris, Lawrence A. *See* Kopp, Otto C. 07147

02012 **Harriss, Robert C.** Mercury content of deep-sea manganese nodules: Nature, v. 219, no. 5149, p. 54–55, table, 1968.

The Hg abundance has been determined in manganese nodules from a variety of geologic environments in the Atlantic, Pacific, and Indian Oceans. All the manganese nodules reported with mercury contents greater than 58 ppb are from regions in the ocean basins which are characterized by volcanic and hydrothermal features. Results suggest that a major source of mercury to deep-sea manganese nodules is submarine volcanic and hydrothermal emanations.—KAS

01994 **Hase, D. H.; Koch, D. L.** Geophysical study of the Keota dome—Keokuk and Washington Counties, Iowa: Geol. Soc. America Bull., v. 79, no. 7, p. 935–940, illus., 1968.

Stratigraphic test drilling has defined a *butterfly*-shaped structural dome which covers about 30 sq mi. Polynomial trend-surface analysis of the geophysical data indicates a near-coincident relationship between the low-order residual anomalies and the closure of Keota dome. Interpretation of these data suggests that the structure possibly may be due to recurrent movement during Paleozoic time along a Precambrian fault which was also the locus of Precambrian intrusive igneous activity. On the basis of geophysical data and stratigraphic considerations the top

of the crystalline complex is estimated to be between 3,000 and 3,500 feet below the surface. It is concluded that ground magnetic and gravity surveys can be used to locate similar structures in southeastern Iowa.—*from* Authors' abstract

01988 **Hasegawa, H. S.** Surface waves observed close to large chemical explosions at Suffield, Alberta: Canadian Jour. Earth Sci., v. 5, no. 2, p. 185–198, illus., tables, 1968.

This study is a continuation of the Suffield Experimental Station seismic program of study of propagation characteristics of large-amplitude seismic waves near multiton, unconfined, chemical explosions, with identification of significant components of the waves, and determination of source mechanism. Results indicate that (1) propagation characteristics are strongly influenced by multi-layering of unconsolidated sediments that overlie sedimentary rocks; (2) the two main components of the surface wave for which ground motion is in radial-vertical plane are of the types predicated: the former component, a constant-frequency wave train, is commonly called an air-coupled Rayleigh wave; and (3) most of the energy of the surface waves is confined to the period range 0.2 to 1.0 sec.—*from* Author's abstract

01977 **Haskin, Larry A.; Haskin, Mary A.** Rare-earth elements in the Skaergaard intrusion: Geochim. et Cosmochim. Acta, v. 32, no. 4, p. 433–447, illus., table, 1968.

The chilled marginal gabbro of the Skaergaard intrusion, East Greenland, is very similar in absolute and relative rare-earth abundances to other gabbros that have been studied. The rocks from the layered series that were analyzed all had rare-earth contents similar to that of the chilled gabbro, except for the specimen from the very top of the series, which was enriched more than ten times. The rare earths appear to have become increasingly concentrated in the magma as solidification progressed, but there was little change in relative abundances. No quantitative sympathetic variation between the rare earths and any major element was observed. Some minor fluctuation in rare-earth abundances appear to be correlated with variations in feldspar contents of the intrusion. It does not appear to be possible to explain the partition of the rare earths by the logarithmic theory.—Authors' abstract

Haskin, Mary A. *See* Haskin, Larry A. 01977

02128 **Hawley, Arthur S.** Wild Goose gas field, Butte County, California, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 642–645, illus., 1968.

The Wild Goose dome is an anticline draped over a basement high. The productive Wild Goose sand is generally accepted as Late Cretaceous in age, the formation is about 925 feet thick and the net sand is 625 feet, of which about 425 feet are gas-bearing. The sandstone is light to medium gray, fine- to medium-grained, clean to silty, with good permeability and porosity. The presence of carbonaceous plant remains and ash fragments, coupled with lateral variability of sandstone to siltstone, suggests that the productive zone is estuarine. The presence of a Tertiary basalt flow was detected in the rocks near the base of the Pliocene.—HRC

Heald, W. R. *See* Kunishi, H. M. 01852

01877 **Healy, Henry G.** Water levels in artesian and nonartesian aquifers of Florida, 1963–64: Florida Div. Geology Inf. Circ. 52, 68 p., illus., table, 1968.

This report summarizes trends and fluctuations of ground-water levels in the principal aquifers in Florida during 1963–64 and includes: hydrographs of ground-water levels in the aquifers, maps showing changes in ground-water levels during specific periods, and a table summarizing principal data on selected observation wells. Because water levels have declined and demand for ground water continues to increase, supplies must be properly appraised before they can be effectively utilized. Objectives of the hydrologic data program of the U.S. Geological Survey

arr to evaluate available ground-water supplies, predict trends of water levels, and delineate present or potential areas of detrimentally high or low levels.—MCM

07146 **Healy, John H.** The transcontinental geophysical survey in the United States, *in* Symposium on Upper Mantle Project, Hyderabad, 1967, Proc.: Hyderabad, India, Natl. Geophys. Research Inst., p. 96–115, illus., table, 1967.

Comparison of geological and geophysical data from a narrow transcontinental band in the United States suggests important new concepts about the properties of the crust and upper mantle, details of which remain to be worked out. Significant regional variation exists in the properties of the upper mantle between the western and the eastern United States, as shown by seismic, aeromagnetic and gravity data.—JPF

Heath, G. Ross. *See* Berger, Wolfgang H. 01812

07222 **Heinrich, E. William; Vian, Richard W.** A barite–quartz phase in the Firesand River carbonatite, Wawa, Ontario: Canadian Mineralogist, v. 9, pt. 2, p. 252–257, illus., 1967.

The Firesand River alkalic complex east of Wawa, Ontario, is unusual in that it consists predominantly of a composite carbonatite core with a highly subordinate outer ring of mafic to ultramafic alkalic silicate rock. Within the carbonatite core is a barite–quartz–carbonate rock, here described in detail, which is believed to have formed by carbonatization of a quartzite xenolith cut by small quartz veins into which were introduced barite, apatite, and carbonate.—*from* Authors' abstract

07155 **Helmstaedt, H.** Mineral lineation and "tectonic transport" in Coldbrook rocks, Beaver Harbour, New Brunswick [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 292, 1967.

Helsley, C. E. *See* Hales, A. L. 02015

01856 **Henriksen, Niels; Watt, W. Stuart.** Geological reconnaissance of the Scoresby Sund fjord complex, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 72–77, illus., 1968.

Two gneiss series were distinguished in the innermost fjord region. The older series is banded veined gneisses, highly deformed, with large-scale isoclinal folds, often recumbent, and containing metadikes; this is covered by garnet–biotite gneisses, only slightly deformed, and flat-lying. A cover–basement relationship is indicated. In the outer parts these two cannot be distinguished. Many gneisses are migmatized and granitized here. If basic dikes cutting these are correlated, the gneisses must be pre-Caledonian, and only slightly affected by the orogeny. Some postmigmatitic, granitic bodies are described. Tertiary basalt-flows in the southern part of the complex reach a thickness of 2,000 m. A raised marine beach was seen on the west side of Rypefjord. One glacier has advanced about seven kilometers in the last 17 years, but the others have not changed.—ESL

01967 **Hermance, John F.** Model studies of the coast effect on geomagnetic variations: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 515–522, illus., 1968.

The effect of a highly conducting ocean on geomagnetic variations was studied by an analog model. Analog model results for a straight coastline show good agreement with analytical results derived for the case of a concentrated current source over the edge of an infinitely conducting ocean. The model was extended to the case of a poorly conducting island of irregular shape in a highly conducting ocean by cutting a hole the desired shape (Iceland) from a large thin sheet of lead. Field observations made near the coastline showed general agreement with the result but suggest that the model overemphasized the coast effect, and indicate that at distances of 50 km or more from the coast, for periods longer than a few minutes, the coast effect can be neglected.—*from* Author's abstract

01732 **Hermes, O. Don.** Geology and petrology of the Mecklenburg gabbro-metagabbro complex, North Carolina [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3751B–3752B, 1968.

01806 **Higgins, Michael W.** Geologic map of the Brevard fault zone near Atlanta, Georgia: U.S. Geol. Survey Misc. Geol. Inv. Map I–511, scale 1:48,000, sections, 1968.

Hilpert, L. S. *See* Moench, R. H. 01901

07272 **Hilpman, Paul L.** Devonian stratigraphy in Kansas—A progress report, *in* Symposium—Silurian–Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 88–98, illus., 1967.

The Silurian–Devonian "Hunton Group" in eastern Kansas can be readily identified in the subsurface on the basis of its lithologic and microfaunal content. Results of, as yet unfinished, investigation of the Kansas Devonian subsurface strata indicate lithologic, faunal, and age dissimilarities of the Devonian carbonate facies to the Hunton type-section of Oklahoma. Conversely, the overlying Chattanooga Shale facies exhibits close lithologic and faunal similarity with the Woodford strata of Oklahoma. Accordingly, it is inferred that a seaway connected Kansas and Oklahoma during Silurian time, but emergence of the Ellis–Chautauqua–Ozark Uplifts during Early and Middle Devonian time developed separate depositional basins north and south of the arch. In Late Devonian time the seaway connection between the two areas was reinstated and black shale deposition continued throughout the region into Early Mississippian time.—*from* Author's abstract

01760 **Ho, Michael Man-Kai.** Energy dissipation in a cohesive soil [abs.]: Dissert. Abs. Sec. B, Sci. and Eng., v. 28, no. 10, p. 4121B, 1968.

07285 **Hodgson, G. W.; Baker, B. L.** Spectra of selected geochemically significant porphyrins and chlorins: Chem. Geology, v. 2, no. 3, p. 187–198, illus., tables, 1967.

Absorption spectra of fifteen metal complexes of geochemically significant chlorins and porphyrins involving copper, nickel, and vanadyl cations show remarkable similarity and yet significant differences which are of value in tracing pigment alteration pathways. Pheophytin *a* and pheophorbide *a* metal complexes have spectra similar to the free pigments, while complexes of derived porphyrins are quite different from the corresponding free compounds. Phylloerythrin and its metal complexes show intermediate characteristics.—Authors' abstract

Hoekstra, Pieter. *See* Low, Philip F. 01848

02080 **Hoffman, R. S.; Taber, R. D.** Origin and history of Holarctic tundra ecosystems, with special reference to their vertebrate faunas, Chap. 8 *in* Arctic and alpine environments—Internat. Assoc. Quaternary Research, 7th Cong., Boulder–Denver, Colo., 1965, Proc., V. 10: Bloomington, Ind., and London, Indiana Univ. Press, p. 143–170, illus., tables, 1968.

Although arctic and alpine tundras have similar vegetation types, their climates, physical environments, and histories are different; their vertebrate faunas differ greatly. The alpine tundra fauna evolved in late Tertiary in rising mountains of central Asia, which still support a rich fauna, and spread along mountain chains to the Alps and Rocky Mountains during Pleistocene cold phases; interglacial and Hypsithermal warm phases exterminated relict populations in the peripheral highlands, where few primary tundra forms remain. The arctic (lowland) tundra fauna originated in north-central Siberia, developed during alternating cold and temperate climate phases, did not reach Arctic America until late Pleistocene. This fauna was also restricted to refugia during warm phases, but its homogeneity was maintained by frequent reconstitution of the circumpolar arctic tundra and ease of dispersal.—VMJ

07193 **Hollister, L. S.** Sector zoning in staurolite, Kwoiek area, British Columbia [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 292–293, 1967.

01767 **Holmes, T. C.** Dome Mines Limited, *in* Geology and ore deposits of Tisdale township: Ontario Dept. Mines Geol. Rept. 58, p. 82–98, 1968.

Discovery of the Dome mine in 1909 was one of the first in the Porcupine district; through 1963 it had yielded over eight million ounces of gold. Orebodies lie on the south limb of the syncline. Greenstones of two ages are the oldest rocks, followed by carbonaceous shale, latite breccia, and Timiskaming sedimentary rocks. The latter occur in a steep trough which has not been explained. Two large and some smaller bodies of porphyry and highly altered carbonate bodies formed by replacement of a fault zone have been found. Deformation has produced linear fabrics. Gold occurs in quartz or ankerite veins, and occasionally in wallrock; sulfides are present in all ore. Silver is recovered in the ratio of one ounce to six ounces of gold. Orebodies may be classified as: long narrow veins in schist, lenticular or irregular quartz veins in massive rocks, mineralized rock, and silicified greenstone.—ESL

07315 **Hood, William C.; Custer, Richard L. P.** Mass magnetic susceptibilities of some trioctahedral micas: Am. Mineralogist, v. 52, nos. 11–12, p. 1643–1648, illus., table, 1967.

Mass magnetic susceptibility values of 38 trioctahedral micas range from 0.74×10^{-6} cgs to 74.84×10^{-6} cgs and are found to be a function of total iron content according to the relationship: $\log K_m = 0.0827 + 1.1435 \log Fe_2O_3$. Oxidation state of the iron influences mass magnetic susceptibility less than total iron content, with ferrous iron imparting a slightly higher susceptibility than ferric iron.—Authors' abstract

07305 **Hooks, W. Gary.** Implications of paleocurrent directions in the Red Mountain Formation of Silurian age near Bucksville, Alabama [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 3, p. 230–231, 1967.

01885 **Hopkins, William S., Jr.** Subsurface Miocene rocks, British Columbia–Washington, a palynological investigation: Geol. Soc. America Bull., v. 79, no. 6, p. 763–767, illus., 1968.

Subsurface Miocene sedimentary rocks have been recognized in the Whatcom basin of southwestern British Columbia and northwestern Washington in two deep exploratory wells using palynological techniques. The flora is characteristic of a warm temperate to temperate climate and probably represents three basic assemblages: (1) warm temperate, probably growing on the basin lowland, (2) temperate, probably growing on uplands on the basin margins, and (3) a much smaller assemblage characteristic of somewhat higher elevations and, therefore, probably well back from the basin margins.—Author's abstract

Horn, M. E. *See* Chapman, S. L. 01855

01694 **Hosman, R. L.; Long, A. T.; Lambert, T. W.** (and others). Tertiary aquifers in the Mississippi embayment, *with discussions of* Quality of water, by H. G. Jeffery: U.S. Geol. Survey Prof. Paper 448–D, p. D1–D29, illus., tables, 1968.

Tertiary aquifers contain water with <1,000 ppm dissolved solids in an area of about 75,000 sq mi and are used as sources of supply in most of this area; total withdrawal is about 500 mgd. Two or more aquifers are available for development, although generally only the shallowest is used; most are areally extensive and are recharged by precipitation on outcrop and downward percolation from overlying alluvium where outcrops are covered by Quaternary deposits. Although hydraulic characteristics differ from aquifer to aquifer and vary within any aquifer, permeabilities of the lower Wilcox are generally more consistent and higher than for others; the Memphis aquifer–Sparta Sand is most productive. All contain water of good quality which generally deteriorates with depth. Flowing wells can be obtained in a few low-lying areas.—*from* Authors' abstract

01978 **Hostetler, P. B.; Christ, C. L.** Studies in the system MgO–SiO_2–CO_2–H_2O—[Pt.] 1, The activity-product constant of chrysotile: Geochim. et Cosmochim. Acta, v. 32, no. 5, p. 485–497, illus., tables, 1968.

Experimental determination of the activity-product constant of chrysotile at 90°C yields the value of $K = 10^{-49.2} \pm 10^{0.5}$. A synthetic sample and a natural sample from New Idria, Calif., were used in the determination. Values were calculated for temperatures ranging from 0° to 200°C using the thermochemical data of King and others (1967) for chrysotile and antigorite, various solubility data for silica, and ionic partial molal heat capacities estimated by the method of Criss and Cobble (1964). K_{chr} is $10^{-54.1}$ at O°C, rises to a maximum of $10^{-48.6}$ at approximately 135°C, and is $10^{-49.1}$ at 200°C (all values for the three-phase system, chrysotile plus solution plus vapor). The calculated 90°C value is $10^{-49.1}$, in excellent agreement with the experimental value; for 25°C, the calculated value is $10^{-51.8}$.—*from* Authors' abstract

Hounslow, A. W. *See* Chao, G. Y. 07200

Howard, Arthur D. *See* Starke, George W. 01892

02020 **Howard, Ephraim Manasseh.** Application of the Mössbauer effect in determination of phase diagrams [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4547B, 1968.

01895 **Hoyt, John H.** Barrier island formation—Reply [to discussion of 1967 paper by C. W. Cooke, 1968]: Geol. Soc. America Bull., v. 79, no. 7, p. 947, 1968.

In reply to Cooke's discussion (ibid., p. 945–946), Hoyt points out that he does not discuss the question of "sufficient" submergence in the late Holocene; part of the problem may be differences in interpretations as to when the Holocene began. Whatever limit of Holocene is used, however, there has been a significant rise in sea level or submergence of land during the past several thousand years, and it is during the latter part of this submergence that the major barrier islands formed. Evidence is given to show that the Hatteras barrier islands formed before the sea attained its present altitude; the Florida Keys are not relevant to the discussion because they formed as coral reefs and are relict Pleistocene features.—VSN

01933 **Hsu, L. C.** Selected phase relationships in the system Al-Mn-Fe-Si-O-H—A model for garnet equilibria: Jour. Petrology, v. 9, no. 1, p. 40–83, illus., tables, 1968.

Bulk compositions of almandine and spessartine were investigated hydrothermally, and stability relations of synthetic samples were determined in terms of temperature, fluid pressure, and oxygen fugacity. Stability of almandine strongly depends on the oxygen fugacity, in contrast to that of spessartine which is stable up to 930°C. Garnets are rare in igneous rocks, but when present are predominately spessartine, confined to felsic magmas; they are absent from mafic rocks because thermal stability ranges of iron-rich members are below the solidus. Scarcity of almandine in contact metamorphosed pelitic rocks may reflect high oxidation state in aureoles rather than inappropriate P-T conditions. Mn:Fe ratios of garnet coexisting with chlorite and quartz might indicate temperature. Rarity of spessartine apparently stems from low Mn values in rock bulk composition.—GDC

01957 **Huag, Pat; Schnoes, H. K.; Burlingame, A. L.** Aromatic carboxylic acids isolated from the Colorado Green River Formation (Eocene): Geochim. et Cosmochim. Acta, v. 32, no. 3, p. 358–361, illus., 1968.

Several series of aromatic carboxylic acids (including mono-, di-, and trimethyl benzoic; mono-, di, and trimethyl propanoic; mono- and dimethyl butanoic; indanoic and tetrahydronaphthoic; and naphthoic acids) have been isolated from the extract of Colorado Green River Shale. Gas liquid chromatographic and both low and high resolution mass spectrometric techniques were utilized for separation and characterization respectively.—Authors' abstract

Huff, Warren D. *See* Bassarab, Dennis R. 02007

07194 **Hughes, C. J.** Beryllium in a granitisation cycle [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 293, 1967.

07306 **Hughes, Travis H.** Some chemical limits of the ore forming solutions, Cave-In-Rock district, Illinois [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 3, p. 230, 1967.

01919 **Hülsemann, Jobst.** Morphology and origins of sedimentary structures on submarine slopes: Science, v. 161, no. 3836, p. 45–47, illus., 1968.

Submarine slopes in deep water, such as continental slopes, are often indented by valleys or channels and made uneven by ridges or levees. The origins of many of these features are unknown or disputed. Morphologically, however, there is often great similarity between forms on deep slopes and forms on shallow slopes or on land. Structurally the slopes in deep water are less well explored, but several observations reveal features, such as lamination and crossbedding, that are known from shallow water also. Measurements of current indicate that periodically the movement of water near the bottom is fast enough to move particles of sediment from time to time. Morphology, fine structure, and currents suggest that internal waves and associated currents, as well as gravity, may control the shape of deep submarine slopes analogously to the shaping by surface waves of slopes in shallow water.—Author's abstract

07253 **Hunt, John M.** Geoscience research in the oceans [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 286–287, 1967.

01913 **Hurley, P. M.** The confirmation of continental drift: Sci. American, v. 218, no. 4, p. 52–64, illus., 1968.

Evidence accumulated in the past five years from studies of polar wandering, sea-floor spreading, age dating and regional geology has led to the current popularity of the concept of continental drift. Some contradictory evidence is mentioned, but not discussed.—DWR

07220 **Ingamells, C. O.; Gittins, J.** The stoichiometry of scapolite: Canadian Mineralogist, v. 9, pt. 2, p. 214–236, illus., tables, 1967.

Chemical analyses of scapolites have been evaluated by a formalized procedure, and it is concluded that natural scapolites may usually be represented as solid solutions of two end-members—meionite and marialite. One unusual sample appears to have chlorine and four hydrogen atoms substituting for carbon in the meionite end member. It is suggested that many of the trace elements and some of the major elements are present in submicroscopic inclusions and not in the scapolite structure. Three new scapolite analyses are presented.—*from* Authors' abstract

07273 **Ireland, H. Andrew.** Regional depositional basins and correlation of Siluro Devonian beds using arenaceous Foraminifera and acid residues, *in* Symposium—Silurian-Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 99–118, illus., table, 1967.

Silurian and Devonian rocks in the Midcontinent and Texas were deposited in a miogeosyncline and on a shelf, although local tectonic variations affected various basins at different times during the Paleozoic. A major regional unconformity occurs between the Middle Silurian and Lower Devonian throughout the region. Arenaceous Foraminifera and insoluble residues can be used to discriminate units within the Hunton Group of Silurian and Devonian age. Five Silurian and two Devonian zones are described. While the Foraminifera cannot be used for direct correlation of all of the units, they can help identify the position of the portion of the section being examined as they occur only within one of the zones of the Silurian.—*from* Author's abstract

Ito, J. *See* Frondel, C. 07207

Ito, Jun. *See* Wilkins, R. W. T. 07235

02135 **Jackson, K. E.; Bourns, G. E.** Alexander gas field, Alberta, Canada, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 705–712, illus., table, 1968.

The Alexander gas field is in central Alberta 20 mi northwest of Edmonton. The producing beds in the Alexander field, known as the Calahoo and the Alexander Sandstones, are the uppermost sandstone units of the Ellerslie Member, Mannville Group, of Early Cretaceous age. Production is obtained at an average depth of 3,800 ft from stratigraphic traps in these sandstone beds. From its discovery in 1949 to February 5, 1966, the Alexander field had produced 102,205,476 Mcf of sweet gas. Twenty-eight wells have been drilled in the area, of which 13 presently are capable of gas production.—Authors' abstract

Jackson, Kenneth A. *See* Uhlmann, Donald R. 07186

Jackson, M. L. *See* Alexiades, C. A. 07151

Jacobs, J. A. *See* Dosso, H. W. 02167

07153 **Jambor, J. L.** New lead sulfantimonides from Madoc, Ontario—Pt. 2, Mineral descriptions: Canadian Mineralogist, v. 9, pt. 2, p. 191–213, tables, 1967.

Launayite, playfairite, sterryite, twinnite, guettardite, and sorbyite are new lead sulfantimonides from Madoc, Ontario. An additional sulfosalt, designated mineral QM, may be identical to Coleman's (1953) mineral Q from Yellowknife, N.W.T. The new minerals are associated with boulangerite, jamesonite, antimonian baumhauerite (Sb:As is about 1:1), zinckenite, semseyite, geochronite, robinsonite, and a few other sulfides and sulfosalts. [For the new minerals, the following data are given: X-ray powder, crystallographic, optical, chemical and physical.]—Author's abstract

01692 **James, H. L.; Dutton, C. E.; Pettijohn, F. J.; Wier, K. L.** Geology and ore deposits of the Iron River–Crystal Falls district, Iron County, Michigan: U.S. Geol. Survey Prof. Paper 570, 134 p., illus., tables, geol. maps, 1968.

The Iron River–Crystal Falls district is a synclinorium of the Precambrian Animikie Series. Basic dikes, sills, and a few granitic bodies are the only intrusive rocks. Unmetamorphosed rocks are a single Keweenawan diabase dike and remnants of Cambrian(?)–Ordovician sediments. Iron-rich beds occur at several horizons; the principal unit of economic interest is the Riverton Iron Formation. Where unoxidized, it consists of interbedded chert and siderite, locally with layers of stilpnomelane and magnetite; iron content is about 25 percent and from 1882 through 1961, 175 million tons of direct-shipping ore was mined. Ore bodies occur in synclinal structures and formed by a process of irregular oxidation to great depths in the zone of aeration and vadose water, local entrapment of water in upward-facing structures leading to dissolution and replacement of chert, and periodic expulsion of silica-charged waters.—HLJ

James, Lawrence B. *See* Jansen, Robert B. 01937

02035 **James, Odette Francine Bricmont.** Origin and emplacement of the ultramafic rocks of the Emigrant Gap area, California [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4623B–4624B, 1968.

01937 **Jansen, Robert B.; Dukleth, Gordon W.; Gordon, Bernard B.; James, Lawrence B.; Shields, Clyde E.** Earth movement at Baldwin Hills Reservoir—Closure [to discussion of paper 5330, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 6016, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 1051–1052, 1968.

Discussion of other dam failures would have been welcome. Investigators of failures have an important obligation to share their findings as some of the most significant lessons are learned from disasters.—ESL

Jedlicka, John. *See* Aaker, Robert. 02148

01798 **Jeletzky, J. A.** Macrofossil zones of the marine Cretaceous of the western interior of Canada and their correlation with the zones and stages of Europe and the western interior of the United States: Canada Geol. Survey Paper 67-72, 66 p., illus., 1968.

Marine Cretaceous macrofaunas of the Canadian western interior are quite closely allied to those of Europe, although only a few species have, hitherto, been recognized as common to both regions. A number of the zonal index species of western Canada or North America are, however, considered to be conspecific with well known European zonal indices. It is hoped that further research will considerably increase the number of zonal indices peculiar to western Canada and North America. It is now possible to subdivide the Cretaceous of western Canada into European stages and substages, so that there is no further need to introduce local stages or substages. These conclusions are also valid for the western interior of the United States.—*from* Author's abstract

01867 **Jensen, Stig Bak.** Field work in the Frederikshaab area, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 40–44, 1968.

Hornblende schists and amphibolites found as lenticular layers in the gneisses on both sides of Frederikshaabs Isblink probably all belong to the same unit; some are more transformed than others. The relation between these schists and those of the Tartoq Group is more obscure. Gneisses in the northeastern Neria area contain a band of brown garnet–mica schist and one of amphibolite without ultrabasic lenses; these are interpreted as a unit different from those farther west. The dolerite dike generations described from the Neria area continue into this area.—ESL

02066 **Jensen, Vagn.** Pseudotachylite in the Agto area, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 22–23, 1968.

Glassy pseudotachylite was found in several localities, restricted to major movement zones which strike NE–SW, dip 45° NW, and are about 200 m wide. The pseudotachylites are clearly intrusive, with a maximum vein width of five centimeters, and formed late in the development of the area. Under the microscope, fluidal structures and spherulitic areas are seen. The presence of these veins shows that intense crushing has taken place along these zones.—ESL

02171 **Jessop, Alan M.** Three measurements of heat flow in eastern Canada: Canadian Jour. Earth Sci., v. 5, no. 1, p. 61–68, illus., tables, 1968.

Heat flow measurements, with appropriate corrections for the effects of Wisconsin glaciation, from three widely separated locations in eastern Canada are reported. One value in the Grenville rocks of Ontario agrees with earlier published values, but, when corrected for the effects of glaciation, becomes close to the world average value. The heat flow found in the New Quebec part of the Superior Province is significantly lower than is found in the Grenville Province. This can be explained by a hypothesis based on geochemical analysis of the surface rocks.—Author's abstract

01761 **Jhaveri, Dilip Purshottamdas.** Earthquake forces in tall buildings with setbacks [abs.]: Dissert. Abs. Sec. B, Sci. and Eng., v. 28, no. 10, p. 4121B–4122B, 1968.

Joensuu, Oiva. *See* Fisher, David E. 01926

John, Edward C. *See* Cooper, James B. 01878

07232 **Johns, W. D.; Sen Gupta, P. K.** Vermiculite–alkyl ammonium complexes: Am. Mineralogist, v. 52, nos. 11–12, p. 1706–1724, illus., tables, 1967.

The structures of a series of alkyl ammonium–vermiculite complexes were examined by unidimensional Fourier methods, supplemented by microcarbon analyses to confirm alkyl ion content. With any given alkyl ion, a series of complexes forms with differing 001 periodicities. In each case the alkyl chain orientation is maintained at 55±5°. The variations in periodicity are due to variations in degree of interfingering of alkyl chains attached to each adjacent silicate surface. General formulae for the multiple series of alkyl–vermiculite complexes are given.—*from* Authors' abstract

Johns, W. D. *See* Bissada, K. K. 07317

Johnson, J. G. *See* Boucot, A. J. 07271

01984 **Johnson, Noye M.; Likens, Gene E.; Bormann, F. H.; Pierce, Robert S.** Rate of chemical weathering of silicate minerals in New Hampshire: Geochim. et Cosmochim. Acta, v. 32, no. 5, p. 531–545, illus., tables, 1968.

The losses of dissolved Ca, Na, Mg and K have been determined for six small watersheds in New Hampshire during the period 1963–1967. From the rate at which Ca and Na are lost, the steady-state chemical weathering rate is calculated at 800 kg of bedrock-till per hectare per year. Under podzol weathering conditions, a major part of the K and Mg released by the breakdown of primary minerals is apparently retained in pedogenic clays.—Authors' abstract

Johnson, Rolfe S. *See* Clark, L. M. 02133

01702 **Johnson, Ross B.** Geology of the igneous rocks of the Spanish Peaks region, Colorado: U.S. Geol. Survey Prof. Paper 594-G, p. G1–G47, illus., tables, geol. map, 1968.

The Spanish Peaks region is well known for its highly diverse igneous rocks and structures. The region is dominated by mountains, peaks, hills, buttes, and walls that are formed by stocks, laccoliths, sole injections, plugs, sills, and dikes. Dikes are characteristic of the region and are members of a large radial system associated with the Spanish Peaks, a smaller radial system associated with Dike Mountain, or a large subparallel system. Many dikes, however, belong to small sets or occur singly. The igneous rocks make up a continuous serial gradation from granite to gabbro, and include phaneritic, aphanitic, porphyritic, and lamprophyric varieties. The rocks range from felsic to ultramafic, oversaturated to undersaturated, peraluminous to subaluminous, and calcic to alkalic types.—RBJ

02123 **Jones, Vern.** Natural gas in Sacramento and northern San Joaquin Valleys, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 597–603, illus., tables, 1968.

Most gas produced in the Sacramento and northern San Joaquin Valleys is from Upper Cretaceous, Eocene, and Pliocene strata. A chart is given to show the age of the producing horizons in the various fields in the valleys and production for 1964 and 1965 is summarized in a table.—HRC

01779 **Jones, W. A.** Hollinger Consolidated Gold Mines Limited, *in* Geology and ore deposits of Tisdale township: Ontario Dept. Mines Geol. Rept. 58, p. 102–115, table, 1968.

The Hollinger gold mine, in the southwest quarter of the township, was discovered in 1909; through 1959 it produced 17,366,470 oz of gold and 3,296,714 oz of silver. A closely folded series of Keewatin lava flows, the Tisdale Group, now hydrothermally altered, are intruded by Algoman porphyry stocks along the axis of the anticline. The main ore zone conforms to attitudes of the porphyry masses, and a large fault zone lies in the central part of the ore zone. Rocks are highly schistose and altered. Orebodies consist of quartz veins, stringer lodes, and stockworks; their relation to structure is discussed. Second generation quartz can be seen and ankerite may form a selvage along contacts. A vein-forming sequence is suggested.—ESL

01780 **Jones, W. A.** Kayorum Gold Mines Limited, *in* Geology and ore deposits of Tisdale township: Ontario Dept. Mines Geol. Rept. 58, p. 118–122, 1968.

A program of geologic mapping, sampling, and diamond-drilling was carried out in 1937, but no further work has been done on this property 4,000 feet south of the Hollinger mine. All rocks are part of the Keewatin Tisdale Group lava flows. Post-Timiskaming folding was superimposed upon the previously deformed flows. A number of veins outcrop, chiefly in the northeast corner, but no gold was found.—ESL

07261 **Jones, Walter B.** Roland McMillan Harper [1878–1966]: Alabama Acad. Sci. Jour., v. 38, no. 2, p. 111–113, portrait, 1967.

01859 **Jörgensen, Ole.** K/Ar age determinations from western Greenland—[Pt.] 2, The Ivigtut region, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 87–91, 1968.

The Ivigtut region contains the transition between two Precambrian fold belts. In the northeast, sediments and volcanics of the Ketilidian fold belt lie unconformably on gneisses and schists of the pre-Ketilidian basement, but to the south the supracrustal rocks show an increasing grade of metamorphism and the unconformity disappears as the basement is reactivated. Mafic dikes, cutting the basement only, become increasingly altered to the southeast. Age determinations were carried out on samples from a dike and from country rock. Results from eight samples show progressive updating from pre-Ketilidian to Ketilidian age.—ESL

01747 **Joshi, Martand Shripadrao.** The genesis of the granitic and associated rocks of the Box Springs Mountains, Riverside, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4175B, 1968.

Joyner, B. F. *See* Lichtler, W. F. 01872

07184 **Jumikis, A. R.** Upward migration of soil moisture by various mechanisms upon freezing, *in* Physics of snow and ice—Internat. Conf. on Low Temperature Science, Sapporo, Japan, 1966, Proc., V. 1, Pt. 2: Sapporo, Japan, Hokkaido University, p. 1387–1399, illus., 1967.

The theory of a possible effective mechanism for soil moisture transfer upon freezing, discussed in this paper, shows that the property of a colloidal soil particle carrying an electric charge on its surfaces, and the functioning of soil moisture films surrounding the particles as an electrolyte are of basic significance in the process set in motion by the external, primary, thermal potential of freezing. The studies permit formulation of various soil moisture transfer mechanisms and verify intervals of their existence as a function of porosity, and the establishment of the concept of a soil freezing system as a thermal system.—VSN

Karrh, John B. *See* Stephenson, Henson K. 07301

07172 **Katsura, Takashi.** Pele's hair as a liquid of Hawaiian tholeiitic basalts: Geochem. Jour., v. 1, no. 4, p. 157–168, illus., tables, 1967.

The chemical composition of Pele's hair seems to be important for illustrating the variations in chemical compositions of the Hawaiian tholeiitic basalts including the iron-rich members. The tholeiites in Hawaii are divided into two groups: one includes a series of rocks whose compositions can be explained by mixing of the magma of Pele's hair and olivine, and the other includes those whose compositions can be explained by subtracting plagioclase and clinopyroxene from the magma of Pele's hair. By using the value of the mole ratio $FeO:FeO_{1.5}$ in the Pele's hair, the liquidus temperature of the magma of Pele's hair is estimated to be 1,160° 10°C at an oxygen partial pressure of $10^{-8.2}$ atm.—Author's abstract

02180 **Kay, Marshall.** Discussion—"Stratigraphy and sedimentary environments of some Wilderness (Ordovician) limestones, Ottawa Valley, Ontario", by C. R. Barnes [1967]: Canadian Jour. Earth Sci., v. 5, no. 1, p. 166–169, illus., 1968.

Lowvillian, Chaumontian, and Rocklandian limestones have lithic facies within each stage. Conodont faunules listed from Rockland and Pakenham quarries in the Ottawa Valley are from misidentified stratigraphic levels in Chaumontian and lower Rocklandian limestones. [See ibid., v. 4, p. 209–244, 1967.]—Author's abstract

Kaye, C. A. *See* Emery, K. O. 01928

02155 **Keahey, Robert A.** Fashing field, Atascosa-Karnes Counties, Texas, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 976–981, illus., 1968.

Fashing field gas occurs in the Edwards Limestone in the deep Edwards fault trend. The structure is dominated by a simple, northeast-trending up-to-the-coast fault with effective closure against the upthrown side. The fault has a maximum vertical displacement of 700 feet at the Edwards level and decreases upward to a displacement of 320 feet at the Eocene Carrizo Sand level. Oil in the Weigang field is trapped in the Carrizo level. The fault dips northwestward, with the angle of dip decreasing downward. Edwards gas comes from 2 distinct zones.—*from* Author's abstract

Keen, Charlotte. *See* Fenwick, D. K. B. 01975

Keen, M. J. *See* Fenwick, D. K. B. 01975

Kehn, Thomas M. *See* Wood, Gordon H., Jr. 01781

Kehn, Thomas M. *See* Wood, Gordon H., Jr. 01782

Kehn, Thomas M. *See* Trace, Robert D. 01802

Keil, Klaus. *See* Snetsinger, Kenneth G. 07230

02095 **Kelly, Thomas E.** Gas accumulations in nonmarine strata, Cook Inlet basin, Alaska, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 49-64, illus., tables, 1968.

Commercial oil and gas have been found only in Tertiary rocks assigned to the Kenai Formation, composed of sandstone, siltstone, conglomerate, shale, and coal. Lateral variations make correlation difficult, but three arbitrarily defined units can be recognized. The Cook Inlet basin is mainly a result of Late Cretaceous-Early Tertiary deformation. All of the oil and gas is located near the crests of local structural closures on anticlinal belts within the basin. Accumulation of oil in the Hemlock Zone, the principal oil reservoir, is related to old fold belts. Gas in the middle and upper parts of the Kenai Formation is indigenous, and was generated from coal and lignite in the section. Stratigraphy, diagenesis in the carbonaceous source rocks, and time of folding control accumulation.—*from* Author's abstract

07249 **Kendall, Robert.** The essence of the seismic reflection method [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 285, 1967.

01889 **Kennedy, J. M.** A microwave radiometric study of buried karst topography: Geol. Soc. America Bull., v. 79, no. 6, p. 735-742, illus., table, 1968.

To prove the potential of microwave surveys in locating and mapping subsurface voids, a mobile laboratory was used to obtain *in situ* data. This unit is equipped with passive microwave radiometers operating at 13.4 GHz (2.22 cm), 37 GHz (8.1 mm), and 94 GHz (3.2 mm). An area near Cool, El Dorado County, California, is known to have well-developed subsurface karst and has been surveyed by the California Highway Department and the California Rock and Gravel Company. The microwave survey showed significant radiometric "cold" anomalies associated with void-space beneath several tens of feet of soil cover. Detection was positive in almost all cases. Microwave systems may be used to greatly reduce surveying costs in the areas where caves have developed beneath cover.—*from* Author's abstract

Kent, Bion H. *See* Roen, John B. 01803

Kerr, Paul F. *See* Megrue, George H. 01902

01956 **Kharkar, D. P.; Turekian, K. K.; Bertine, K. K.** Stream supply of dissolved silver, molybdenum, antimony, selenium, chromium, cobalt, rubidium and cesium to the oceans: Geochim. et Cosmochim. Acta, v. 32, no. 3, p. 285-298, tables, 1968.

Using a freeze-dry method of concentration with high purity sodium carbonate as carrier, 12 rivers from the United States and the world have been analyzed each for several or all of the following elements: Ag, Sb, Cr, Co, Rb, Cs, Se and Mo. The greatest variations in concentration among the rivers were observed for Sb, Cr and Mo. In addition to the dissolved trace-element load of streams an attempt was made to estimate the additional supply of soluble material to the oceans as the result of adsorption on particles in streams and desorption on contact with sea water. Cobalt has an additional supply by this mechanism equal to about twice the dissolved load while Ag and Se add only an additional 10 percent more and Cr and Mo none.—Authors' abstract

02024 **Kim, Young Il.** Some geomorphic processes in the Perris basin, Riverside County, California [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4615B, 1968.

01748 **Kirchgasser, William Thomas.** Paleontology and stratigraphy of the concretions and limestones of the Upper Devonian Cashaqua shale member, Sonyea Formation, New York [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4175B–4176B, 1968.

07196 **Klein, E.; Trautz, O. R.; LeGeros, J. P.; LeGeros, R. Z.; Rosenbaum, C.** Polarized infrared study of single crystals of apatite [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 294, 1967.

Klein, E. *See* LeGeros, R. Z. 07197

Klute, A. *See* Raats, P. A. C. 01840

01749 **Knight, Colin Joseph.** Rubidium-strontium isochron ages of volcanic rocks on the north shore of Lake Huron, Ontario, Canada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4176B, 1968.

01836 **Ko, Hon-Yim; Scott, Ronald F.** Deformation of sand at failure: Am. Soc. Civil Engineers Proc., v. 94, paper 6028, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 883–898, illus., 1968.

The failure conditions in an Ottawa sand are studied by means of a new soiltest box and stress control device. Failure envelopes for the soil in a medium dense and medium loose state are obtained and plotted on an octahedral plane. The relation between the failure stress and the void ratio of the soil is also obtained for the soil under triaxial compression and triaxial extension stress states.—Authors' abstract

Koch, D. L. *See* Hase, D. H. 01994

07302 **Koch, Walter F.** Geography at Alabama—Past and present [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 3, p. 234, 1967.

07274 **Koenig, John W.** The Ozark Uplift and Midcontinent Silurian and Devonian stratigraphy, *in* Symposium—Silurian-Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 119–147, illus., 1967.

The Ozark Uplift is a north-south oriented area which was tilted to the northwest during the Silurian and Devonian. Silurian rocks were deposited around the raised southeast corner. In the Devonian, the rise of the Chautauqua Arch to the west joined the Uplift to the Transcontinental Arch. To the south the Ouachita Trough was formed, and various other basins were formed to the north. Silurian and Early Devonian clastic rocks came from the east and south of the uplifts, while during the Devonian, clastic rocks were derived from within the assembly of structures. Epeirogenic movement controlled sedimentation in the basins. The Silurian is uniformly distributed; the Lower Devonian is absent in the northern part of the region, and the Middle Devonian is absent in the southern part.—*from* Author's abstract

02056 **Koeppel, V.** Age and history of the uranium mineralization of the Beaverlodge area, Saskatchewan: Canada Geol. Survey Paper 67-31, 111 p., illus., tables, 1968.

Uranium–lead ages were determined for samples of pitchblende, uraninite, etc. Based on these ages and on the lead isotope ratios of galena and clausthalite, it is shown that the formation and evolution of the mineral deposits [of the Beaverlodge area] took place during six discrete periods covering a time span of more than 2,200 m.y. Analytical procedures are discussed and the validity of the results using various techniques is examined. New upper and lower age limits are suggested for the Martin Formation and for the diabase dikes of the area. It is concluded that isotopic data from pitchblende samples can be used to determine the age and evolution of the ore deposits. [Descriptions of samples from epigenetic and syngenetic deposits are appended.]—Author's abstract

01733 **Kohut, Joseph James.** Quantitative analysis, taxonomy, and distribution of Middle and Upper Ordovician conodonts from the Cincinnati region of Ohio, Kentucky, and Indiana [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3752B, 1968.

Komura, Saburo. *See* Shen, Hsieh W. 01788

07147 **Kopp, Otto C.; Harris, Lawrence A.** Synthesis of grunerite and other phases in the system SiO_2–NaOH–Fe–H_2O: Am. Mineralogist, v. 52, nos. 11–12, p. 1681–1688, tables, 1967.

Grunerite has been synthesized in the above system at 1.6 kb. Grunerite was more abundant near the bases of the vessels (400–430°C) than in the upper parts (360–410°C). In the uppermost part of the vessels it is supplanted by micaceous phases, resembling Na–nontronite, Na–vermiculite, or stilpnomelane, and by an unusual fibrous glass. The role of sodium ions in the formation of grunerite and the micaceous phases was demonstrated by similar experiments using KOH as a solvent which produced no amphibole and only the mica, ferriannite.—*from* Authors' abstract

07278 **Kottlowski, Frank E.; Pray, Lloyd C.** Silurian outcrops of southcentral and southwestern New Mexico, *in* Symposium—Silurian–Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 209–230, illus., table, 1967.

The Fusselman Dolomite, which crops out in many of the isolated mountain ranges of the region, is largely gray, finely to medium crystalline, massive, but slightly porous, tan-weathering dolomite; it is more than 1,000 feet thick in the southern area, and 600 to 800 feet thick in the type area in the Franklin Mountains of Texas. Lower, middle, and upper members are here designated the Chamberino, Flag Hill, and Crazycat, respectively. The formation thins to a knife-edge toward the north and west; it overlies Ordovician rocks and is overlain mostly by various Late Devonian rocks, but by Middle Devonian rocks in the southernmost parts of New Mexico. In the subsurface to the east, it is overlain by "Upper Silurian" carbonates or shales or by an unconformity with various rocks above it. Dolomitization has destroyed most of the fossils. The sedimentary environment of the formation is discussed also.—HRC

01734 **Kramer, Kenneth Francis.** Oxygen compound acidity and oxygen polarization as a control in silicate weathering [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3752B–3753B, 1968.

01765 **Krech, Warren Willard.** The determination of the mechanical properties of rock and soil by means of a hollow cylinder loaded with external pressure [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3698B, 1968.

01764 **Kreidler, Eric Russell.** Stoichiometry and crystal chemistry of apatite [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3670B, 1968.

01770 **Krieger, Medora H.** Geologic map of the Saddle Mountain quadrangle, Pinal County, Arizona: U.S. Geol. Survey Geol. Quad. Map GQ-671, scale 1:24,000, sections, separate text, 1968.

Map units described in the text range from surficial deposits to Precambrian Pinal Schist.—MCM

Krinsley, David H. *See* Newman, Walter S. 01815

01888 **Krinsley, David H.; Donahue, Jack.** Environmental interpretation of sand grain surface textures by electron microscopy: Geol. Soc. America Bull., v. 79, no. 6, p. 743–748, illus., 1968.

More than 4,000 quartz sand grain surfaces have been examined by electron microscopy, and it has been established that specific differences exist depending on the environment of transportation and deposition. Littoral, aeolian, glacial, diagenetic, and combinations of these four environments can be distinguished; river transport and turbidity current movement do not impress characteristic surface textures on quartz sand grains.—Authors' abstract

02142 **Krueger, Max L.** Occurrence of natural gas in Green River basin, Wyoming, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 780–797, illus., 1968.

Important gas producing units in the western part of the Green River basin include sandstone beds in the Frontier and Mesa Verde Formations (Cretaceous) and lenticular sandstone bodies of early Tertiary age, which appear to have developed in lake basin margins. Combinations of structural and stratigraphic traps occur in most instances. Geologic factors such as the basin's 30,000-ft-thick section, its thrust faulted and structurally complex borders, the presence of several regional fold trends which may have compound geologic histories, and the notable facies changes, especially in the Mesozoic and Tertiary beds, all suggest that much more extensive gas reserves can be developed in the basin.—*from* Author's abstract

02158 **Krusekopf, H. H., Jr.** Bethel field, Anderson County, Texas, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 1008–1012, illus., table, 1968.

The Bethel field is in northern Anderson County. It encloses the Bethel salt dome; most production is from the west and east sides. The field was discovered by Texaco Inc. in 1956, when oil was found in the Woodbine Formation. In 1957 Texaco discovered gas in the Rodessa. The total gas reserve in the Rodessa at Bethel field is estimated to be about 95 billion cu ft.—Author's abstract

Kulm, L. D. *See* Nelson, C. Hans. 01920

01958 **Kumarapeli, P. S.; Coates, M. E.; Gray, N. H.** The Grand Bois anomaly—The magnetic expression of another Monteregian pluton: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 550–553, illus., 1968.

An aeromagnetic anomaly, similar to the ones associated with known Monteregian plutons, occurs over a low hill at Grand Bois, about 4 km west of Mount Johnson. In the area of this anomaly, a gravity high of over 1.60 mgals and also two outcrop localities with igneous rocks of Monteregian types, were detected. Therefore, it is concluded that the aeromagnetic anomaly is caused by a blind Monteregian pluton, for which the name "Grand Bois Intrusion" is proposed.—Authors' abstract

01852 **Kunishi, H. M.; Heald, W. R.** Rubidium-sodium exchange on kaolinite and bentonite: Soil Sci. Soc. America Proc., v. 32, no. 2, p. 201–204, illus., tables, 1968.

Experimental data on the exchange between Rb and Na on Hawthorn kaolinite from Florida and Utah bentonite clays were examined in terms of the exchange equation of Heald et al (ibid., v. 28, p. 622–627, 1964). The results could be interpreted in terms of a single selectivity factor, describing the relative tendencies of the two ions to form ion pairs with the charge on the clay surface when it was assumed that the amount of each ion present in the form of ion pairs was a constant fraction of the total amount of ion present. The bentonite data show that at moderate Rb saturation, Rb ion pair formation is favored by decreasing salt concentration.—GDC

07276 **Kunsman, Howard S.** Hunton oil and gas fields, Arkansas, Oklahoma, and Panhandle Texas, *in* Symposium—Silurian–Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 165–197, illus., tables, 1967.

The Hunton Limestone was found to be productive in 1921; since that time 4,300 wells in 200 fields have produced 277 million bbl of oil. The largest field is West Edmond, Okla., having produced 38 percent of the total. Development depths range from 1,900 to 21,000 feet. Production in the Arkoma Basin is from the Sallisaw and Quarry Mountain Formations, named from outcrops in northeastern Oklahoma. Other production is from formations named from exposures in the Arbuckle Mountains, though subsurface correlation is difficult because of lithofacies problems. Gas reserves increase with depth in the Anadarko Basin.—HRC

Kuroda, P. K. *See* Sabu, D. D. 01998

Kuroiwr, Daisuke. *See* Nakaya, Ukichiro. 07170

02121 **Lafayette Geological Society; New Orleans Geological Society; Meyerhoff, A. A.** (editor, and others). Geology of natural gas in south Louisiana, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 376–581, illus., tables, 1968.

South Louisiana contains 111 trillion cu ft of gas in reserve. The Gulf Coast geosyncline began in the Triassic and attained maximum development in the Cenozoic; the total section in south Louisiana is 40,000 to 60,000 feet. Sedimentation rate has increased since the Triassic and the depositional axis has migrated gulfward. The maximum thicknesses of units are on the downthrown sides of growth faults. The concurrence of a large provenance, a great volume of sediment, abundant organic matter, rapid deposition and burial, and movements of an underlying salt layer which produced syndepositional structural traps, created optimum conditions for the generation and entrapment of large hydrocarbon reserves. More gas than oil is below and (or) associated with deep-water sediments, and where shale is a major constituent.—*from* Authors' abstract

01703 **Lai, Tung-Ming.** Pathways of cationic diffusion in clay minerals [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3557B–3558B, 1968.

01893 **Lamb, George M.** Stratigraphy of the lower Mancos Shale in the San Juan Basin: Geol. Soc. America Bull., v. 79, no. 7, p. 827–854, illus., table, 1968.

The lower half of the Mancos Shale in the northern part of the San Juan Basin can be divided into, in ascending order, the Graneros Shale, Greenhorn Limestone, Carlile Shale, and Niobrara Shale. The Juana Lopez Member allows the Carlile to be further divided into an upper and lower Carlile Shale. Tongues of shallow marine and continental sediments extend into the Mancos from the south, representing several transgressions and regressions of varying extent. These sediments are not seen along the northern side of the basin, but the changing conditions of sedimentation are reflected in vertical changes of the microfauna. Six distinct foraminiferal zones are present in the lower Mancos. The faunal assemblages within these zones give an indication of the conditions which prevailed within the basin during the time represented by the Mancos sediments.—*from* Author's abstract

Lambert, A. *See* Fenwick, D. K. B. 01975

Lambert, T. W. *See* Hosman, R. L. 01694

01874 **Lane, H. C.** Preston Mines Limited—Preston East Dome Mine, *in* Geology and ore deposits of Tisdale township: Ontario Dept. Mines Geol. Rept. 58, p. 143–151, 1968.

Rocks in the gold mine area are entirely Precambrian—Keewatin flows and Timiskaming graywacke intruded by Algoman feldspar porphyry and later diabase dikes. Dynamic metamorphism accompanied by metasomatism converted volcanic rocks into ferro-carbonate and talc-chlorite schist. The mine is located on the north

limb of the syncline and the Destor–Porcupine fault zone, marking the southern boundary for ore, strikes northeast across the south side of the property; a fault branch opened fractures permitting emplacement of orebodies. Early production was from within porphyry, but at present only 25 percent is porphyry ore. Producing zones described are: replacement zones in Preston Porphyry, quartz and sulfide veins in the greenstone zone; stockwork in the porphyry greenstone zone; and fissure fillings in the west porphyries zone.—ESL

01741 **Langston, Robert Burlington.** The nature of anauxite [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4113B–4114B, 1968.

01716 **Langton, J. Roger; Chin, George E.** Rainbow Member facies and related reservoir properties, Rainbow Lake, Alberta: Bull. Canadian Petroleum Geology, v. 16, no. 1, p. 104–143, illus., 1968.

The large reserves of oil and gas recently discovered in the Rainbow Lake area of Alberta occur in Middle Devonian biohermal reefs, designated the Rainbow Member of the Keg River Formation. Reefs are characterized by pinnacle or atoll form and develop to a maximum height of 800 feet. A detailed study of lithofacies and reservoirs is reported here. Five distinct pore systems recognized in the Rainbow Member reefs are shown to be related to lithofacies and to type, degree, and age of diagenesis. Patterns of lithofacies distribution are distinctive for large and small pinnacle reefs and for large atoll and crescent-atoll reefs. Five reservoir facies are established, each with distinctive pore system and system of conveying canals.—VSN

01858 **Larsen, Ole; Möller, Jörgen.** K/Ar age determinations from western Greenland—[Pt.] 1, Reconnaissance programme, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 82–86, table, 1968.

Preliminary results of K–Ar age determinations on samples from western Greenland presented in the 1966 report have been checked, and the corrected figures are tabulated. Details are given for five new dates; four are Precambrian and one pre-Tertiary. The earlier dates include eleven from the Nagssutoqidian fold belt, eight from the central basement gneiss unit, seven from the Ketilidian fold belt, five rocks of Gardar age, and two of pre-Gardar age.—ESL

Larson, E. E. *See* Strangway, David W. 01949

Lasalle, P. *See* Terasmae, J. 01971

01976 **LaSalle, Pierre; Chagnon, Jean-Yves.** An ancient landslide along the Saguenay River, Quebec: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 548–549, illus., 1968.

The largest landslide (8 square miles) yet reported in eastern Canada is described and two 14C dates (560±90 years B.P., 420±90 years B.P.) believed to be related to the time of its occurrence are presented.—Authors' abstract

01715 **Latimer, I. S., Jr.** The geologic data program: West Virginia Geol. Survey Newsletter, 11th issue, p. 3–4, illus., 1968.

The Geologic Data Section of the State Survey was established in 1965. A listing of material on hand includes 53,000 well logs, 4,000 measured sections, 2,000 core-drill logs, 600 well sample and core descriptions, and 10,500 chemical analyses. The records have been transferred to microfilm, the data transcribed for storage and retrieval by computer, and computers used to perform detailed investigations. The microfilming uses an aperture card system in which two sides of a well log can be reproduced on one frame of film. Types of cards used in the computer program are described. The drawing of maps and entering of data on them are of special interest. Benefits are found to be greater than anticipated.—ESL

Lawrence, D. E. *See* Lee, Hulbert A. 02059

01750 **Learned, Robert Eugene.** The solubilities of quartz, quartz–cinnabar and cinnabar stibnite in sodium sulfide solutions and their implications for ore genesis [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4176B–4177B, 1968.

07240 **Leavens, Peter B.; White, John S., Jr.** Switzerite, $(Mn,Fe)_3(PO_4)_2{\cdot}4H_2O$, a new mineral: Am. Mineralogist, v. 52, nos. 11–12, p. 1595–1602, illus., tables, 1967.

The new mineral switzerite, found at King's Mountain, N. C., occurs with vivianite in seams in spodumene–rich pegmatite. It is pale pink or light golden–brown when fresh, but it commonly oxidizes to shades of brown. Switzerite occurs as bladed crystals or micaceous masses, flattened on [100]. Observed forms include a [100], x [210], y [410], n [101], e [101], p [111], q [111]. Cleavage is perfect [100] and fair [010]. Switzerite is monoclinic, P 2/a, a=17.099, b=12.694, c=8.282A, $\beta=95°55'$, Z=8; the three strongest X–ray powder lines are 8.550 (100), 2.585 (60), 7.128 (40). Optically, switzerite is negative, α (calc.)=1.602, $\beta=1.628$, $\gamma=1.632$, $2V=42°$, Y=b, Z:c=10 1/2°. The mineral is named for George Switzer of the Museum of Natural History, Smithsonian Institution.—*from* Authors' abstract

02101 **Lee, Charles A.** McDonald Island gas–storage field, San Joaquin County, California, *in* Natural gases in rocks of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 102–103, illus., 1968.

Details of storage of gas in the old, depleted McDonald Island gas field are described. The reservoir is a sand in the Meganos–Martinez unit below the Capay Shale which is serving as the cap. Structurally, the field is an anticline which has been faulted, the faults apparently providing the closure in part. It is estimated that 50 billion cubic feet of gas can be stored in the structure.—HRC

02059 **Lee, Hulbert A.; Lawrence, D. E.** A new occurrence of kimberlite in Gauthier township, Ontario: Canada Geol. Survey Paper 68–22, 16 p., illus., tables, 1968.

A dike rock exposed in the underground workings of the Upper Canada mine [at Dobie], Kirkland Lake region, has been identified as kimberlite. It consists of two generations of olivine and phlogopite, pyrope, magnetite, chromite, perovskite, pyrrhotite, apatite, calcite, and serpentine. The pyrope and olivine are rich in magnesium as they are in other kimberlites. The Al_2O_3 and SiO_2 values are low, TiO_2 moderate, MgO high and trace elements Ba, Sr, B, Nb, Zr, Pb and V are high. The K–Ar age of the dike is 151±8 m.y. Its magnetic susceptibility is $4{,}000\times10^{-6}$ e.m.u. Fundamentally, the kimberlite from this mine is similar in bulk chemistry, trace–element concentrations and in mineral assemblage to kimberlites from Siberia and South Africa.—*from* Authors' abstract

Lee–Hu, C. *See* Wetherill, G. W. 01903

LeGeros, J. P. *See* Klein, E. 07196

LeGeros, J. P. *See* LeGeros, R. Z. 07197

LeGeros, R. Z. *See* Klein, E. 07196

07197 **LeGeros, R. Z.; Trautz, O. R.; LeGeros, J. P.; Klein, E.** Carbonate substitution in the apatite structure [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 294, 1967.

01824 **Lehnert–Thiel, Klaus; Vohryzka, Kurt.** Untersuchungen an Hg–Aureolen um polymetallische Sulfidgänge im Permafrostboden Ostgrönlands, 72°nl. Breite: Montan–Rundschau, v. 16, no. 5, p. 104–108, illus., 1968.

Principles of geochemical prospecting by the mercury halo method are considered as applied in the Mesters Vig area of East Greenland. The special permafrost conditions in residual soils hinder neither the development of mercury aureoles around the polymetallic sulfides nor their search and interpretation. The level of the mercury aureole in the soil and its dispersion depend much more on the cut depths of the mineral vein. Generally, higher mercury zones are found in the hanging walls. Mineral composition, particle expansion and position of zones are described

from the Blyklippen mine workings, Sorte-Bjerg lead-zinc vein drill-hole, and Rungsted stream exposures. Geochemical profiles are illustrated, as well as schematic mercury dispersion in an ideal Mesters-Vig lode.—GDC

01981 **LePichon, Xavier.** Sea-floor spreading and continental drift: Jour. Geophys. Research, v. 73, no. 12, p. 3661-3697, illus., tables, 1968.

A geometrical model of the surface of the Earth is obtained in terms of rigid blocks in relative motion with respect to each other. With this model a simplified but complete and consistent picture of the global pattern of surface motion is given on the basis of data on sea-floor spreading. In particular, the vectors of differential movement in the "compressive" belts are computed. An attempt is made to use this model to obtain a reconstruction of the history of spreading during the Cenozoic era. This history of spreading follows closely one previously advocated to explain the distribution of sediments in the oceans.—Author's abstract

Leskela, Willard. *See* Nordquist, Jack W. 02140

01751 **Lessing, Peter.** Petrology of the Poundridge leptite, Westchester County, New York [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4177B, 1968.

01752 **Letteney, Cole DeWitt.** The anorthosite-charnockite series of the Thirteenth Lake massif, south-central Adirondack highlands, N. Y. [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4177B-4178B, 1968.

01842 **Lewis, G. Edward.** Stratigraphic paleontology of the Barstow Formation in the Mud Hills area, San Bernardino County, California, *in* Geology of the Fremont Peak and Opal Mountain quadrangles, California: California Div. Mines and Geology Bull. 188, p. 34-35, illus., 1968.

All vertebrate collections made during the Mojave project of the U.S. Geological Survey comprise a fauna comparable to most of Merriam's late Miocene Barstow fauna, coming from the upper part of the Barstow Formation as defined in the accompanying report by Dibblee of the Mud Hills area. However, collections from the Calico and Alvord Mountain areas have yielded middle Miocene fossils, of which examples are mentioned as recorded by other investigators. Collections from the Black Canyon area represent genera and species that also were collected from the upper part of the typical Barstow Formation in the Mud Hills area, indicating correlation with that part above the "lower marker tuff bed" as mapped by Dibblee (1966).—GDC

Libby, W. G. *See* Sinclair, A. J. 07179

01872 **Lichtler, W. F.; Anderson, Warren; Joyner, B. F.** Water resources of Orange County, Florida: Florida Div. Geology Rept. Inv. 50, 150 p., illus., tables, 1968.

Ground water in Orange County is obtained from: a nonartesian aquifer composed of late Miocene to Holocene clastic materials; several discontinuous shallow artesian aquifers in the middle Miocene Hawthorn Formation; and the principal source, the Floridan aquifer composed of Eocene limestone. Most large diameter wells in the Floridan will yield more than 4,000 gpm with quality ranging from moderately hard in the western and central parts to saline in the extreme eastern section. Artificial injection of good quality surplus surface water can increase the amount of water available and improve its quality. Use of ground water in 1963 was estimated to average about 60 mgd.—*from* Authors' abstract

Likens, Gene E. *See* Johnson, Noye M. 01984

07198 **Lin, H. C.; Foster, W. R.** The polymorphism of celsian ($BaAl_2Si_2O_8$) [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 295, 1967.

02036 **Lindholm, Roy Charles.** Petrology of the Onondaga Limestone (Middle Devonian), New York [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4624B, 1968.

01979 **Linn, T. A., Jr.; Moore, C. B.; Schmitt, R. A.** Neutron activation determination of vanadium in iron meteorites and sulfide nodules: Geochim. et Cosmochim. Acta, v. 32, no. 5, p. 561–564, illus., tables, 1968.

The concentrations of V in five meteoritic irons and in nine sulfide nodules from iron meteorites have been determined. An instrumental method is employed using neutron activation without radiochemical separation. The vanadium concentration limit in nickel-iron is less than 0.2 ppm. The sulfide nodules show groupings (at about 2 and 44 ppm V), possibly related to structural class or perhaps to the Ga-Ge group of the meteorite.—KAS

02018 **Lipps, Jere H.** Mid-Caenozoic calcareous nannoplankton from western North America: Nature, v. 218, no. 5147, p. 1151–1152, tables, 1968.

The stratigraphic occurrence of calcareous nannoplankton in rocks of western North America permits correlation with tropical area plankton zones and the type sections of the European stages in spite of differing oceanographic conditions between the two regions during the mid-Cenozoic. These correlations indicate that the California Zemorrian Stage is equivalent to the European Chattian, the Saucesian to the Aquitanian, the Relizian to the Burdigalian and lower Helvetian, the Luisian to the Helvetian, and the Mohnian to the upper Helvetian and lower Tortonian.—KAS

07233 **Lister, Judith S.; Bailey, S. W.** Chlorite polytypism—[Pt.] 4, Regular two-layer structures: Am. Mineralogist, v. 52, nos. 11–12, p. 1614–1631, illus., table, 1967.

Several crystals of purple Cr-chlorite which belong to the chlorite group possessing 2-layer packets made up of two different layer types, have been studied in detail. The apparent space group of one of the 2-layer crystals is Cl with a = 5.335, b = 9.240, and c = 28.735A, and $\alpha = \beta = \gamma = 90°$. The 2-layer repeat is due to a regular alternation of octahedral cations between I and II sites in both the talc and brucite sheets of the two layers. The talc network is distorted by 6° planar rotations of the tetrahedra.—MR

01762 **Liu, Shih-Chi.** Nondeterministic analysis of nonlinear structures subjected to earthquake excitations [abs.]: Dissert. Abs. Sec. B, Sci. and Eng., v. 28, no. 10, p. 4122B, 1968.

Locke, Robert. *See* Osmond, John C. 02108

02161 **Loetterle, G. J.** Willow Springs field, Gregg County, Texas, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 1060–1068, illus., 1968.

Willow Springs, primarily a gas field, is in southeastern Gregg County, Texas, partly in the city limits and partly west of Longview. The productive area is about 34,000 acres. The structure is a low-relief anticline in a structural trend paralleling the East Texas field on the east. Local lensing out of productive sandstones and minor local permeability barriers affect the structurally controlled accumulation. Production is from Cretaceous rocks—Rodessa, Pettet, and Travis Peak—with the most important producing zone being the Young Zone of the Rodessa. The estimated ultimate recovery from all producing zones is 681,500,000 Mcf of gas and 6,114,500 bbls of liquids, of which 550,596,000 Mcf and 5,135,000 bbls had been recovered as of January 1, 1966.—Author's abstract

02116 **Lofton, Coleman L.** Sheridan field, Colorado County, Texas, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 306–329, illus., tables, 1968.

The Sheridan field is outstanding because of the large gas-condensate reserves found in the Wilcox, and is unique for the trend because of the great thickness and number of productive sandstone bodies. The gross thickness of the Wilcox sandstone ranges from 1,200 to 1,700 feet. Forty-three units have been recognized, of which 29 are or have been productive. The structure is a simple, ovate anticline uncomplicated by faulting, on the down side of a down-to-the southeast fault with a throw of 150 feet.—*from* Author's abstract

01843 **Lohman, Kenneth E.** Miocene diatoms from the Black Canyon area, *in* Geology of the Fremont Peak and Opal Mountain quadrangles, California: California Div. Mines and Geology Bull. 188, p. 35–36, 1968.

A collection of mudstone from the Black Canyon area near Opal Mountain has yielded a diatom assemblage of over 25 identified species and varieties, 20 feet stratigraphically above the top of a 2-ft wide tuff marker bed mapped by Dibblee (1966). The diatom flora, listed with relative abundance, bears such close similarity to assemblages from middle and upper Virgin Valley beds of Barstovian age in Nevada, that the beds at Black Canyon may be correlated with them. New species are indicated which are described in a paper now in preparation on diatoms from the Virgin Valley; their presence gives the greatest assurance to the correlation.—GDC

02163 **Lokke, Donald H.; Brent, Millard D.** Geologic conditions associated with nitrogen occurrences in Jurassic oil and gas fields, northeast Texas and southwest Arkansas, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 1074–1084, illus., tables, 1968.

Oil and gas condensate from the Jurassic Smackover Formation in Eylau and Flower Acres fields in Bowie County, Texas, and in Texarkana field in Miller County, Arkansas, yield 60 percent nitrogen. The producing rocks are associated with intrusive igneous rocks and hydrogen sulfide in the two Texas fields. The Texarkana field is in the same diabase petrographic province. Origin of the nitrogen gas is uncertain, but close association with oil and gas-condensate accumulation suggests a related origin.—Authors' abstract

Long, A. T. *See* Hosman, R. L. 01694

02048 **Long, Leland Timothy.** Transmission and attenuation of the primary seismic wave, $\Delta = 100$ to 600 km [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4631B, 1968.

01790 **Longley, C. S.** Porcupine Paymaster Limited, *in* Geology and ore deposits of Tisdale township: Ontario Dept. Mines Geol. Rept. 58, p. 138–141, table, 1968.

The Paymaster property is divided along the township line by an ultrabasic sill. The northern volcanic area, in Tisdale township, is on the south limb of the syncline and gives a cross section of the Keewatin flows, intruded by several quartz porphyry bodies. The main producing area is associated with the Paymaster stock, with veins in all of the lava flows, but especially the Vipond Subgroup.—ESL

07264 **Lopez, Raul Grande.** Morfología y génesis de suelos yesíferos de Matehuala, S. L. P.: Geología y Metalurgía, v. 3, no. 22, p. 5–66, illus., tables, 1967.

This study is concerned with the genesis, morphology, and mineralogy of soils in the area of Matehuala, San Luis Potosí, that show gypsum in their profiles. The gypsum horizon is diagnostic of secondary enrichment; chemical and mechanical action of wind, heat, and occasional rain are discussed. Gypsum could have originated by precipitation from marine waters in an ancient basin, or it could have a Pleistocene origin due to long periods of aridity. Results tabulated include: chemical analysis of rocks and soils, mineralogic analysis by X-ray diffraction of five profiles, measured sections of these profiles, and a summary table.—ESL

Loring, D. H. *See* Emery, K. O. 01928

Loughridge, Michael S. *See* Northrop, John. 01950

01860 **Lövborg, Leif; Hansen, John.** Prospecting instruments used in the survey of uranium-thorium and beryllium in the Ilímaussaq intrusion, South Greenland, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 53–58, 1968.

Since uranium-thorium and niobium mineralizations are most common in the lujavrites of the Kvanefjeld area, and beryllium and niobium are common on the

Taseq slope in the northwestern part of the intrusion, work has been concentrated in these areas. Beryllium minerals are found especially in hydrothermal veins, the most common being chkalovite. Lujavrites show the strongest radioactivity in contact with the roof of the intrusion. Prospecting instruments described are beryllometers, digital geiger-counters, and γ-spectrometer.—ESL

Loveridge, W. D. *See* Wanless, R. K. 01973

01848 **Low, Philip F.; Hoekstra, Pieter; Anderson, Duwayne M.** Some thermodynamic relationships for soils at or below the freezing point—[Pt.] 2, Effects of temperature and pressure on unfrozen soil water: Water Resources Research, v. 4, no. 3, p. 541–544, illus., table, 1968.

Thermodynamic methods are presented for calculating, from the water adsorption isotherms, the change in unfrozen water content of a partially frozen soil with temperature at a constant pressure or with pressure at a constant temperature. Then, using pertinent experimental data for Na-Wyoming bentonite, the increase in unfrozen water caused by a confining pressure of 100 atm is obtained as a function of temperature. Such information is shown to be relevant to the mechanical properties of frozen soils under stress.—Authors' abstract

07156 **Lumbers, S. B.** Copper-nickel mineralization associated with dioritic intrusions in the Bancroft-Madoc area, Ontario [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 295, 1967.

07277 **Lundin, Robert F.** Ostracoda and stratigraphy of the Henryhouse and Haragan Formations in southcentral Oklahoma, *in* Symposium—Silurian-Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 198–208, illus., tables, 1967.

Ostracodes show that an unconformity exists between the Silurian and Devonian in the Arbuckle Mountains; the Haragan Formation is Helderbergian and the Henryhouse Formation is late Niagaran. The Henryhouse contains 46 species in 28 genera, and the Haragan has 54 species in 28 genera. Four major biostratigraphic lines of evidence for the unconformity are described. No distinct zoning occurs within each unit, however. The ostracodes from all areas of outcrop are distinctive and readily identifiable and may be useful in distinguishing the two formations in the subsurface.—HRC

07248 **Lyons, Paul L.** Gravity interpretation of major crustal properties [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 284–285, 1967.

01742 **Lytton, Robert Leonard.** Isothermal water movement in clay soils [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4122B-4123B, 1968.

02053 **Macdonald, G. A.; Gay, T. E.** Geology of the Modoc Plateau: California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 6, p. 92–93, illus., revised 1968; originally published 1966.

The Plateau is capped by basalt plains and shield volcanoes that overlap basin-range structures. Oldest rocks are interbedded lava flows, pyroclastics, and lake deposits, correlated with the Oligocene-Miocene Cedarville Series. Pliocene rocks include volcanic and lake deposits, the latter including diatomite. Basins between ranges were flooded by the Plio-Pleistocene Warner basalt pahoehoe flows. Basalts of Pleistocene to Recent flows with cinder cones and shield volcanoes resemble the Warner basalts; very recent flows are *aa* type. Faults trend northwest to north, and most are normal; earthquakes suggest that some are still active. Large springs issue from the basalts. This paper was originally published without illustrations *in* Mineral resources of California (U.S. Cong., 89th, 2d Sess., Comm. Interior and Insular Affairs, Comm. Print, 1966; also issued as Calif. Div. Mines and Geology Bull. 191, 1966).—ESL

02001 **Macdonald, Gordon A.; Powers, Howard A.** A further contribution to the petrology of Haleakala Volcano, Hawaii: Geol. Soc. America Bull., v. 79, no. 7, p. 877–887, illus., table, 1968.

Sixteen new chemical analyses of the later rocks of Haleakala Volcano, on the island of Maui, Hawaii, add to the differentiation picture for that volcano. The early rocks of the volcano are tholeiitic. These are followed by dominant hawaiites with less abundant alkalic olivine basalts, picrite-basalts of ankaramite type, and a few mugearites. Still later rocks, separated from earlier ones by a profound erosional unconformity, include some hawaiites and ankaramites, but are dominantly alkalic olivine basalts (basanitoids) containing as much as 16.5 percent normative nepheline, some of them transitional to ankaramite. The progression toward ultramafic strongly undersaturated rocks (nephelinites), characteristic of the post-erosional lavas of other Hawaiian volcanoes, appears to have just begun at Haleakala. Authors' abstract

01948 **MacGregor, Ian D.** Mafic and ultramafic inclusions as indicators of the depth of origin of basaltic magmas: Jour. Geophys. Research, v. 73, no. 12, p. 3737–3745, illus., tables, 1968.

Ultramafic and mafic nodules, found as inclusions in basaltic lavas, are mineral assemblages that have formed either as crystal accumulates or by subsolidus recrystallization. The distribution of nodules in basaltic lavas indicates that subalkaline basalt, nepheline-free alkaline basalt, nepheline-bearing alkaline basalt, and kimberlitic basalt are derived from successively greater depths in the upper mantle. The regional distribution of nodule types in basaltic lavas from different tectonic environments allows some estimates of the geothermal gradient. Geothermal gradients in the tectonically active southwestern United States fall between 23° and 45°C per km, whereas gradients beneath the Precambrian shields fall below 23°C per km.—*from* Author's abstract

01689 **Machamer, Jerome F.** Geology and origin of the iron ore deposits of the Zenith mine, Vermilion district, Minnesota: Minnesota Geol. Survey Spec. Pub. Ser. SP-2, 56 p., illus., tables, 1968.

Zenith mine yielded 21 million tons of high grade ore, before closing in 1962. Deposits, which occupy the stratigraphic position of the jaspilitic iron-formation and occur within walls of altered metabasalts, Ely Greenstone, consist of massive hematite, brecciated and cemented by secondary hematite. In lower levels, hematite gives way to carbonate mineral zones. Alteration in the greenstone wallrock is discussed. Carbonate minerals were deposited around 400°C. During ore deposition, fugacities of iron and sulfur were around equilibrium values for coexistence of hematite, magnetite and pyrite, and the fugacity of CO_2 was about 10^3 atm. It is concluded that deposits are postmetamorphic, formed by replacement of silica in the iron-formation by rising heated waters, with metals and fluid derived from depth. Geologic maps of the 17th and 18th levels, and geologic sections accompany the report.—ESL

Macintosh, E. E. *See* Murray, J. W. 01970

Madole, Richard F. *See* Murray, D. Keith. 01712

07244 **Maher, John C.** Geologic framework and petroleum potential of the Atlantic coast: Tulsa Geol. Soc. Digest, v. 35, p. 278–283, illus., 1967.

This is a generalized discussion of the geology of the Atlantic Coastal Plain and continental shelf from the Bahamas and Florida northward to Nova Scotia. The basement of the region, being primarily metamorphic rocks, is described, and the known geophysical trends are outlined. Both gravity and magnetic anomalies reflect primarily compositional differences at considerable depths in the crust but are related to some extent to coastal plain structures. A review of the Mesozoic and Cenozoic sedimentary rocks is included. The shelf offers more promise as a petroleum reservoir than does the Plain because the rocks are thicker and more reservoir-like. The Upper Jurassic and Lower Cretaceous rocks appear to have the greater potential.—HRC

02089 **Major, Jack; Bamberg, Samuel A.** Some Cordilleran plants disjunct in the Sierra Nevada of California, and their bearing on Pleistocene ecological conditions, Chap. 9 *in* Arctic and alpine environments—Internat. Assoc. Quaternary Research, 7th

Cong., Boulder–Denver, 1965, Proc., V. 10: Bloomington, Ind., Indiana Univ. Press, p. 171–188, illus., table, 1968.

Six subalpine to alpine plant taxa are disjunct in a permanently wet area of marble bedrock, the Convict Creek basin on the east front of the Sierra Nevada of California, from the Cordillera as far east as central Colorado and as far north as northeastern Oregon. Their migration to the Sierra Nevada is believed to have been by nearly continuous distribution, requiring habitats across the Great Basin different from conditions there today. Habitats suitable for migration of such plants, riverine bogs over permafrost in a cold, dry continental steppe, exist today in high, continental mountains of central Asia; evidence for such conditions in the Great Basin during glaciations includes patterned ground and the expanded Pleistocene lakes, which indicate colder temperatures, not increased precipitation.—VMJ

07145 **Maloney, Neil J.** Geomorphology of the continental margin off central Oregon, U.S.A. [with Spanish and French abs.]: Oriente Univ. Inst. Oceanog. Bol., v. 6, no. 1, p. 116–146, illus., 1967.

The continental margin west of Oregon between lat 43°50′ N. and 44°40′ N. is 50 to 55 nautical miles wide and consists of the continental shelf, 16 to 35 miles wide, and a continental slope, 16 to 37 miles wide. The continental shelf is erosional in origin with smooth, almost-flat, sediment covered upper and central areas. The western part of the shelf contains four rocky bank areas of irregular topography which appear to be structural highs; depressions east of Stonewall and Heceta Banks may be structural lows. Scarps on Heceta and Siltcoos Banks are possible fault scarps. The continental slope extends from the shelf to the abyssal plain at depths of 1530 to 1610 fm, and bathymetry of the slope suggests it was formed by faulting.—*from* Author's abstract

Mamay, Sergius H. *See* Zen, E-an. 01922

07157 **Mandarino, J. A.** Reflectance spectrophotometry in mineralogy [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 295, 1967.

07191 **Mandarino, J. A.** The Royal Ontario Museum's new gallery of mineralogy [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 296, 1967.

02131 **Manlove, C. F.** Vernalis gas field, San Joaquin County, California, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 663–667, illus., 1968.

Vernalis field is an anticlinal structure, but stratigraphic factors greatly influenced accumulation and local variation in occurrence of gas which is produced from Miocene and Cretaceous beds. Most is from the Cretaceous Moreno and Panoche Formations (D–1 and D–2 zones) which underlie an unconformity. The gas-bearing sand bodies are lenticular and are surrounded by shale; later arching created the anticlines and structural traps.—HRC

07192 **Mannard, G. W.** The surface expression of kimberlite pipes [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 297, 1967.

02174 **Manning, P. G.** Optical absorption spectra of octahedrally bonded Fe^{3+} in vesuvianite: Canadian Jour. Earth Sci., v. 5, no. 1, p. 89–92, illus., 1968.

The optical absorption spectra of green vesuvianite crystals from Lowell County, Vermont, are reported in the energy range 12,000 cm^{-1} to 30,000 cm^{-1}. The principal absorptions have been attributed to octahedrally bonded Fe^{3+} and the individual bands have been assigned to spin-forbidden electronic transitions from $^6A_1$ ground state to excited states in Fe^{3+}. In particular, the $^6A_1$ $^4A_1$ $^4E(G)$ transition is marked by a relatively sharp band at 21,600 cm^{-1}.—Author's abstract

07210 **Manning, P. G.** The optical absorption spectra of the garnets almandine-pyrope, pyrope, and spessartine and some structural interpretations of mineralogical significance: Canadian Mineralogist, v. 9, pt. 2, p. 237–251, illus., tables, 1967.

The optical absorption spectra of the garnets almandine–pyrope from Gore Mountain, Essex County, New York, and Madagascar, pyrope from Moravia, Czechoslovakia, and spessartine from Parry Sound, Ontario, are reported from the near infrared to the near ultraviolet. The spectra show a three–band system in the infrared (4500 cm^{-1}, 6000 cm^{-1}, and 7800 cm^{-1}) that is attributed to 8–coordinate Fe(II). A number of fairly sharp bands in the visible and ultraviolet regions are attributed to either Fe(II) or octahedrally–bonded Fe(III). Some Mn(II) bands have also been observed and assigned.—*from* Author's abstract

Marano, David. *See* Wilson, Stanley D. 01835

March, Stanley. *See* Newman, Walter S. 01924

07158 **Mariano, A. N.** Crystallographic polarity in chalcopyrite [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 297–298, 1967.

02054 **Marlowe, J. I.** Sedimentology of the Prince Gustaf Adolf Sea area, District of Franklin: Canada Geol. Survey Paper 66–29, 83 p., illus., tables, 1968.

Under this Arctic shelf area, a part of the Sverdrup Basin, are moderately deformed sedimentary formations of Mesozoic to Tertiary age, and coastal–plain sand and gravel. The sea bottom, channeled in a dendritic pattern, appears to have been exposed previously to subaerial erosion and recently to ice action; island shelf and slope may represent a standstill 300–400 m below present sea level. Sand transported by ephemeral streams is deposited in shallow depths near shore; sandy layers occur in the subbottom of widespread mud. Cores show an upper, yellow–brown, structureless stratigraphic unit, containing foraminiferal remains and oxidized detrital pyrite, underlain by a laminated gray unit that contains fresh detrital pyrite and no faunal remains. Contacts are generally transitional; widely differing depositional environments are indicated.—GDC

01837 **Marsal, Raúl J.** Large–scale testing of rockfill materials—Closure [to discussion of paper 5128, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 6016, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 1042–1047, illus., table, 1968.

Comments of Brauns and Leussink [ibid., v. 93, no. SM 6, 1967] on danger of failure in individual grains are pertinent. After the paper [ibid., v. 93, no. SM 2, 1967] was presented, tests and theoretical analyses showed that the working hypothesis is not correct, but does take into account the main factors affecting grain breakage. Marsal believes that random phenomena are best treated by statistical methods. Observations by Hillis and Skermer [ibid., v. 94, no. SM 1, 1968] on the influence of the sand–filled membrane on test results are well justified. To clarify this effect, duplicated tests were run, one with the cover described in the paper, the other with rubber membranes. Results indicate that Hillis and Skermer are correct. Due to errors in the signs of strains, the volumetric changes from circumferential extensometers in the paper are wrong; corrected values are plotted.—*from* Author's abstract

01908 **Marshall, N. J.** Rapid determination of molybdenum in geochemical samples using dithiol: Econ. Geology, v. 63, no. 3, p. 291, 1968.

Sodium–carbonate fusion gives more reproducible results with this method than hydrofluoric acid digestion.—WSW

02084 **Marvin, Ursula.** Continental drift: GeoScience News, v. 1, no. 4, p. 4–7, 20–25, illus., 1968.

Continental drift is postulated to explain the apparent fit of continents; truncated structural trends; the pattern of late Paleozoic climatic zones, shown by glacial deposits and fossils; polar wandering, shown by paleomagnetism; and youth and topography of ocean floors. All are discussed in some detail. Continental separation would have been associated mainly with the Atlantic and Indian Oceans. The theory of sea–floor spreading as a cause of continental drift and growth by accretion is supported by belts of magnetic anomalies, associated with oceanic ridges, which record reversals of Earth's magnetic field. Widths of anomaly belts indicate amount

of spreading over the last 4,000,000 yr. Heat-flow values show that ridges may cool for long periods and then become active again. Since all variations of continental drift depend on convection in the mantle, arguments for and against this are reviewed.—ESL

Mason, G. D. *See* Naldrett, A. J. 02176

02149 **Masters, Charles D.** Geology of natural gas occurrence in Tertiary and Late Cretaceous rocks of Sand Wash basin, Colorado and Wyoming, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 866–877, illus., table, 1968.

The Sand Wash basin of northwestern Colorado and south-central Wyoming yields natural gas from rocks of Tertiary and Cretaceous ages. The first discovery of gas was from the Tertiary in 1927, but because of market conditions, development has been slow. In recent years an active exploration program has resulted in markedly increased reserves which, as of 1965, exceeded 550 billion cu ft of high-methane gas. The accumulation of hydrocarbons in the basin is controlled chiefly by structural closure, but only parts of the total Tertiary and Cretaceous stratigraphic column yield gas. A detailed knowledge of the distribution of selected reservoir rocks in relation to the structural configuration will be important in the discovery of new reserves within the basin.—Author's abstract

Matelski, R. P. *See* Petersen, G. W. 01854

Matsumoto, T. *See* Nowacki, Werner. 07291

01829 **Matthews, William H., 3d.** Wonders of fossils: New York, Dodd, Mead and Co., 64 p., illus., 1968.

The seven chapters of the book are titled: desert boneyard, from bone to stone, in search of the past, a geological calendar, what kinds of fossils are there?, finding fossils, and your fossil collection. A page of suggestions for further reading is included.—ESL

07231 **McAtee, James L., Jr.; Cheng, Francis S.** Differences in apparent interstratification of an organo-montmorillonite dispersed in various organic solvents—[Pt.] 2, Electron microscopy study: Am. Mineralogist, v. 52, nos. 11–12, p. 1725–1734, illus., 1967.

An earlier paper (McAtee and Cheng, 1967) reported Fourier analyses of X-ray data from samples of organo-montmorillonite dispersed in various organic solvents, and classified the dispersions into four groups. Electron microscopy of the same dispersions gave the same classification, based on differences in morphology, aggregate size, particle-particle associations, and amount of curling of particles.—Authors' abstract

02009 **McBirney, Alexander R.** Genetic relations of volcanic rocks of the Pacific Ocean: Geol. Rundschau, v. 57, no. 1, p. 2133, illus., 1968.

Study of Hawaiian, Galapagos, and Tahitian magmatic suites shows that volcanic rocks of the Pacific, viewed as a whole, can be explained as products of two distinct processes. Generation of basaltic magmas at greater depths in the mantle results in increasing alkalinity, and prolonged magmatic activity results in tapping of progressively deeper horizons. Differentiation of an individual basalt will lead to a series of rocks with a distinctive character reflecting the parent basalt and conditions of differentiation. The less voluminous strongly alkaline rocks of mature volcanic centers may represent a smaller fraction of the parent rocks than common tholeiites of the sea floor and younger volcanoes. Tholeiites may offer a means of studying regional compositional variations in the top of the upper mantle but undifferentiated alkaline basalts and basanites provide the only insight into deeper levels.—DBV

01713 **McCallum, M. E.** Cenozoic history of the east-central Medicine Bow Mountains, Wyoming: Mtn. Geologist, v. 5, no. 2, p. 69–81, illus., tables, 1968.

Evidence of three major episodes of erosion and two reversals of stream flow direction during the Tertiary is present in the east-central Medicine Bow Mts.: (1) late Eocene(?)-early Oligocene(?) pre-White River erosion; (2) late Oligocene(?)-early Miocene(?) drainage direction reversal and pre-North Park erosion surface development; (3) late Miocene-early Pliocene deposition of North Park Formation and equivalent gravels; (4) late Pliocene(?)-early Pleistocene drainage direction reversal in central mountains, development of Medicine Bow surface, and deposition of quartzite gravel deposits; and (5) late Pleistocene-Recent glaciation and minor stream dissection of Medicine Bow surface. Wisconsin glacial deposits are well developed in the northern part of the area, and five stadial moraines are recognized.—MCM

01735 **McCave, Ian Nicholas.** A stratigraphical and sedimentological analysis of a portion of the Hamilton Group (Middle Devonian) of New York State [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3753B, 1968.

07159 **McConnell, Duncan.** Crystal-chemical calculations [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 298, 1967.

07160 **McConnell, Duncan.** Biomineralogy—Its applications [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 298, 1967.

02025 **McCoy, Roger Michael.** An evaluation of radar imagery as a tool for drainage basin analysis [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4616B, 1968.

07161 **McDougall, D. J.** Application of thermoluminescence to geological problems [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 298, 1967.

07162 **McDougall, D. J.** The role of excited electrons in "ground preparation" for replacement ore deposits [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 299, 1967.

01906 **McGinnis, Lyle D.** Glacial crustal bending: Geol. Soc. America Bull., v. 79, no. 6, p. 769-775, illus., 1968.

In the central regions of an ice cap, crustal deflection will be directly related to ice cap thickness and deflection beneath the ice will produce crustal tilting in the vicinity of the ice margin. The angle of tilt may determine the amount of uplift, a forebulge, at the ice margin. The order of magnitude of tilting can be obtained from the relative uplift of shorelines of glacial lakes and from sub-ice Greenland profiles. Approximate tilts of 0.3-0.7 percent are estimated for North America and Greenland, which would produce ice marginal uplifts of approximately 80-185 meters. Areas where evidence for contemporary and past uplifts may be found are suggested, but such features would be difficult to identify.—*from* Author's abstract

07275 **McGlasson, E. H.** The Siluro-Devonian of west Texas and southeast New Mexico, *in* Symposium—Silurian-Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 148-164, illus., 1967.

The Siluro-Devonian rocks of the subsurface of west Texas and southeastern New Mexico consist of four lithologic units: the Fusselman Formation, the "Upper Silurian" unit, the "Devonian" unit, and the Woodford Formation. The Fusselman Formation consists of limestone and dolomite; the "Upper Silurian" unit of shale, limestone, and dolomite; the "Devonian" unit of chert and siliceous limestone; and the Woodford Formation of dark shale. The Caballos Formation, which crops out in southwest Texas, is composed of chert and novaculite and is thought to be correlative with all four of the subsurface units.—*from* Author's abstract

01865 **McGregor, V. R.** Field evidence of very old Precambrian rocks in the Godthaab area, West Greenland, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 31-35, 1968.

Reactivation of parts of the central complex is indicated by dates around 1800 m.y. The Ameralik dike swarm, the best key to the history, cuts rocks of a reworked

basement within the pre-Nagssugtoqidian, pre-Ketilidian complex. East of Godthaab, dikes are so abundant in some units that failure to find them in adjacent units may indicate these are younger than the dikes. All dikes have been strongly deformed, and all rocks were affected by deformation characterized by abundant minor folds overturned to the east, with major overthrusting or nappe folding. This was followed by plutonic activity, culminating in strong migmatization and intrusion of a calc-alkaline suite. The area was then subjected to intense stretching, and plutons rose diapirically, forming domes. Both the Ameralik dikes and the rocks they cut are older than a 2700 m.y. date obtained earlier, and may be as old as the 3600 m.y. Katarchean.—ESL

02058 **McLeod, C. R.** The preparation of polished sections at the Geological Survey of Canada: Canada Geol. Survey Paper 68-8, 16 p., illus., 1968.

Procedures used in the production of polished sections are divided into three main stages: (1) mounting and impregnation of samples, using vacuum; (2) grinding, with diamond-impregnated laps; and (3) machine polishing, using diamond-oil mixtures on lead laps. A simplified flow sheet outlines the steps involved at the ore polishing laboratory established by the Mineral Deposits Section of the Geological Survey of Canada. Polishing with the Dürener machine is not quick, but the sacrifice of quantity for quality is justified by the detail revealed in the sections thus made. Standardization of technique is impossible, and adaptation to individual situations is necessary. Examples are given as a guide in dealing with problems of diversity of materials.—GDC

McMullen, R. M. *See* Swift, D. J. P. 01987

01776 **McNitt, James R.** Geologic map and sections of the Kelseyville quadrangle, Mendocino, Lake, and Sonoma Counties, California: California Div. Mines and Geology Map Sheet 9, scale 1:62,500, sections, text, 1968.

The northwest-trending Mayacmas Mts. are the principal physiographic feature of the Kelseyville quadrangle, an area notable for its association of quicksilver deposits and hot springs. Formations described are unnamed Jurassic-Cretaceous rocks, Pliocene Merced(?) and Cache Formations, Pleistocene volcanic rocks of Clear Lake, and terrace, lake, and alluvial deposits. Landslides, most common near fault zones in pre-Tertiary rocks underlying the mountains, have been offset by several large, northwest-trending faults tilted to the northeast. Movement along the faults has occurred on arcuate segments ranging from 1/2 to 2 mi in length and with average radius about 1 mi. Seismic activity indicates that faulting is still active; many earthquake epicenters are located in the Mayacmas Mts. and surrounding area.—MCM

02037 **Meade, Robert Francis.** Molluscan paleoecology of the Fernando Group of the southern Ventura basin, California [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4625B, 1968.

01706 **Meagher, Edward Patrick.** The crystal structure and polymorphism of cordierite [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3808B-3809B, 1968.

01902 **Megrue, George H.; Kerr, Paul F.** Alteration of sandstone pipes, Laguna, New Mexico—Reply [to discussion of 1965 paper by R. H. Moench and L. S. Hilpert, 1968]: Geol. Soc. America Bull., v. 79, no. 6, p. 791-794, 1968.

Megrue and Kerr in reply to the discussion by Moench and Hilpert (ibid., p. 787-790) adhere to their thesis that the sandstone pipes were formed by hydrothermal solutions which forced their way upward through plateau strata with resultant brecciation, alteration, and collapse. Absolute age data indicate formation of uranium-bearing minerals at about 90-94 m.y. or just before Middle Cretaceous.—VSN

01925 **Meighan, Clement W.; Foote, Leonard J.; Aiello, Paul V.** Obsidian dating in west Mexican archeology: Science, v. 160, no. 3832, p. 1069-1075, illus., tables, 1968.

Obsidian hydration analysis has been used to date artifacts in western Mexico. The hydration rate for western Mexico is based on a correlation of obsidian readings and radiocarbon dates from the Morret site on the coast of Colima. A hydration rate of 260±15 years per micron is proposed for Morret obsidian. Applications of obsidian dating in western Mexico are as follows: direct age determinations, determination of the time range during which a given site was occupied, check on the integrity of other dating evidence, and determination of time range of individual artifact types.—KAS

07171 **Mellor, Malcolm; Smith, James H.** Creep of snow and ice, *in* Physics of snow and ice—Internat. Conf. on Low Temperature Science, Sapporo, Japan, 1966, Proc., V. 1, Pt. 2: Sapporo, Japan, Hokkaido University, p. 843–855, illus., tables, 1967.

Constant load creep tests in uniaxial unconfined compression were carried out on samples of sintered snow and polycrystalline ice under the assumption that creep follows the Arrhenius relation. Results indicate that creep of polycrystalline ice depends on dislocation damping for the process at high stress and on drift of dislocations pinned by stress-induced order for low-stress mechanism. If each mechanism has a characteristic activation energy, apparent activation energy may vary with stress level. In snow at a given nominal stress, such an effect should be reflected in variation of apparent activation energy with bulk density. The effect of bulk density on strain rate and prediction of creep rates for snow from data on that in polycrystalline ice are discussed.—VSN

01707 **Merkle, Arthur Beiser.** The crystal structure of heulandite [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3809B, 1968.

07245 **Merriam, Daniel F.** Use of computers by geologists [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 283–284, 1967.

01754 **Merrill, Ronald Thomas.** Origin of the remanent magnetization and magnetic reversals in the Bucks pluton, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4178B–4179B, 1968.

01917 **Meyer, Henry O. A.** Chrome pyrope—An inclusion in natural diamond: Science, v. 160, no. 3835, p. 1446–1447, table, 1968.

Electron-probe analyses of garnets that are rich in magnesium and that occur as inclusions in natural diamonds show that the chrome-garnet end member, $Mg_3Cr_2Si_3O_{12}$, is a major constituent (30 percent).—Author's abstract

Meyerhoff, A. A. *See* Lafayette Geological Society. 02121

07163 **Middleton, G. V.** Albite of secondary origin, after perthite, in sandstones of the Charny Formation, Quebec [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 300, 1967.

01821 **Milici, Robert C.** The physiography of Sequatchie Valley and adjacent portions of the Cumberland Plateau, Tennessee: Tennessee Div. Geology Rept. Inv. 22, [15] p., illus., table, reprinted 1968; originally published 1967.

This was originally published in Southeastern Geology, v. 8, no. 4, p. 179–193, 1967. (*See* Abstracts of North American Geology, May 1968).—MCM

01721 **Miller, Thomas P.; Ferrians, Oscar J., Jr.** Suggested areas for prospecting in the central Koyukuk River region, Alaska: U.S. Geol. Survey Circ. 570, 12 p., illus., tables, 1968.

Anomalous amounts of copper, lead, zinc, silver, and gold in stream-sediment samples and mineralized outcrops define seven areas favorable for prospecting in the central Koyukuk River region, west-central Alaska. These areas, listed with their metals of interest, are (1) Indian Mountain: silver, lead, copper, and gold, (2) Sun Mountain: lead, copper, and silver, (3) Dakli: copper, (4) Clear Creek: gold, (5) Caribou Mountain: uranium and thorium, (6) Hawk River: lead and silver, and (7) Purcell Mountain: gold. Mineralization at all these localities is closely related

to granitic plutons of Late Cretaceous age. These plutons are intrusive into volcanic rocks ranging in composition from quartz latite to andesite and in age from possible Late Jurassic to Early Cretaceous.—Authors' abstract

Miller, Thomas P. *See* Patton, William W., Jr. 01809

02150 **Millison, Clark.** Gas occurrence in Upper Cretaceous and Tertiary rocks of Piceance basin, Colorado, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 878–898, illus., table, 1968.

In the Piceance basin of western Colorado, gas has been found in several sandstone zones in the Upper Cretaceous (upper part of Mancos and Mesaverde) and Tertiary (Fort Union, Wasatch, and Green River) beds. All producing beds in the Upper Cretaceous and Tertiary section have marked facies changes which are predominantly important in the trapping of gas, although some anticlinal features also are influential. Total gas production from these beds to January 1, 1966, was about 71 billion cu ft, and established reserves are probably nearly 12 times that quantity. Future prospects for the basin as a source of natural gas are good.—*from* Author's abstract

02134 **Mills, B. A.** Solution-gas reserves in Pembina Cardium oil field, Alberta, Canada, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 698–704, illus., 1968.

Oil and gas in Pembina Cardium field are present in sandstone in the Cardium Formation of Late Cretaceous age. The reservoir is a stratigraphic trap which resulted from the updip "shale out" of the sandstone. Local structures had little or no control on the accumulation. The Cardium Formation is divided into five units, the upper one of which is the principal reservoir; it is a well-sorted, clean sandstone with good porosity and permeability. The conglomerate and stray sands in other units also contain some accumulation.—*from* Author's abstract

Ming, Roger W. *See* Davis, James F. 01934

02146 **Mitchell, Steven D.** Geology and occurrence of natural gas in Laramie and Hanna basins, Wyoming, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 828–839, illus., tables, 1968.

Eight small anticlinal fields are known in Laramie and Hanna basins. Mesozoic rocks are largely clastic and are from repeated marine and continental transitions. By the end of the Cretaceous, recurrent basement uplift occurred and Late Cretaceous and Cenozoic terrestrial deposition accumulated in the rapidly sinking Laramie and Hanna basins. Both basins are basement controlled, are downwarped asymmetrically, and have divergent structural elements. Gas has been found only in sandstone reservoirs. Only structural traps are known, but stratigraphic drilling is just beginning. The proved reserves appear minor in comparison to the potential, especially in the Hanna basin.—*from* Author's abstract

01901 **Moench, R. H.; Hilpert, L. S.** Alteration of sandstone pipes, Laguna, New Mexico—Discussion [of paper by G. H. Megrue and P. F. Kerr, 1965]: Geol. Soc. America Bull., v. 79, no. 6, p. 787–790, 1968.

Moench and Hilpert disagree with Megrue and Kerr's findings (ibid., v. 76, p. 1347–1360, 1965) that the sandstone pipes near Laguna, N. Mex., were formed after induration of surrounding sediments and have great vertical discontinuity. Published data reviewed here show that the pipes formed in Late Jurassic during deposition of enclosing sediments, have limited vertical extent within Jurassic rocks, and formed largely by foundering of unconsolidated and semiconsolidated sediment into spring vents during compaction and expulsion of water.—VSN

01884 **Moiseyev, Alexis N.** The Wilbur Springs quicksilver district (California) example of a study of hydrothermal processes by combining field geology and theoretical geochemistry: Econ. Geology, v. 63, no. 2, p. 169–181, illus., 1968.

The mercury deposits are in Mesozoic rocks of the Great Valley sequence, adjoining sheared Franciscan terrane to the west. They are associated with masses of "detrital" serpentine, rather than with intrusive serpentine. Hot springs have the same spatial distribution as the mercury deposits. Their waters are considered to be largely connate, heated by volcanic sources. On the basis of the amount of mercury, the flow of the springs, and the age of the deposits, it is estimated that mercury concentration was about 5×10^{-6} m/l. Thermodynamic calculations suggest that transport as sulfide complex or as colloid is most likely. Source of the mercury may have been a magma or the sediments.—WSW

Möller, Jörgen. *See* Larsen, Ole. 01858

01766 **Monney, Neil Thomas.** Engineering aspects of the ocean floor [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3699B, 1968.

07164 **Mookherjee, A.; Suffell, G. G.** Some sulphide–diabase relationships in Ontario and Quebec [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 300, 1967.

01986 **Mookherjee, Asoke; Suffel, G. G.** Massive sulfide–late diabase relationships, Horne mine, Quebec—Genetic and chronological implications: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 421–432, illus., tables, 1968.

At the Horne mine, Noranda, evidence of penetration and apparent replacement of 'Late Diabase' dikes by massive sulfides, led several workers to believe that these dikes were older than the orebodies. However, a glassy selvage of the diabase against a sulfide wall, in contrast with a microcrystalline one against adjoining rhyolite, demonstrates a different rate of cooling against materials of different thermal diffusivity. Dissociation of pyrite to magnetite, increase in monoclinicity of pyrrhotite, copious development of chalcopyrite blebs in sphalerite, and some interesting sulfide–sulfide and sulfide–silicate reactions in the contact zone also record unmistakable imprints of thermal metamorphism of the sulfide wall.—*from* Authors' abstract

Moore, C. B. *See* Linn, T. A., Jr. 01979

Moore, Gerald K. *See* Wilson, Charles W., Jr. 01800

07224 **Moore, Paul B.** A classification of sulfosalt structures derived from the structure of aikinite: Am. Mineralogist, v. 52, nos. 11–12, p. 1874–1876, tables, 1967.

In the bismuthinite–aikinite series, minerals of quantized composition such as gladite, hammarite, and Welin's (1967) new composition have been observed. The following general formula was derived for the series: $Cu_xPb_zBi_{8Z-x}S_{12Z}$ where Z is an integral multiple of the a-translation in aikinite for the superstructure and x is a multiple of 4 and less than 4Z. Formula and chemical compositions of aikinite derivatives with Z less than 7 are given, and a method for nomenclature is discussed.—JLH

07239 **Moore, Paul B.** Crystal chemistry of the basic manganese arsenate minerals—[Pt.] I, The crystal structures of flinkite, $Mn_2^{2+}Mn^{3+}(OH)_4(AsO_4)$ and retzian, $Mn_9^{2+}Y^{3+}(OH)_4(AsO_4)$: Am. Mineralogist, v. 52, nos. 11–12, p. 1603–1613, illus., tables, 1967.

The crystal structure of flinkite is derived from pyrochroite-like sheets by removing some of the octahedra and substituting AsO_4^{3-}-tetradentate tetrahedra between the sheets. The Mn^{3+}-centered oxygen octahedra are elongate square bipyramids, consistent with Jahn–Teller tetragonal distortions in an octahedral crystal field. The retzian structure consists of sheets built of Mn^{2+}-centered oxygen octahedra and Y^{3+}-centered oxygen square antiprisms. As in flinkite, the AsO_4^{3-}-tetrahedra are situated between the sheets.—*from* Author's abstract

07189 **Moore, R. K.; White, W. B.** Optical spectra of iron in garnets [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 301, 1967.

Morain, Stanley A. *See* Simonett, David S. 02092

01833 **Morinage, Shigeru; Uchida, Kinsuke.** Geology and ore deposits of the Whitehorse ore zone, Yukon Territory, Canada [in Japanese with English abs.]: Mining Geology, v. 18 (2–3), nos. 88–89, p. 115–133, illus., 1968.

Exploration of the old copper prospect at Whitehorse, Yukon, by geological and geophysical prospecting and by diamond drilling located significant ore reserves; mining operations began in late 1966. The deposits are of pyrometasomatic type with several kinds of contact-metamorphic silicates; bornite and chalcopyrite are the principal copper sulfides with valleriite found locally. Mineralization is in both Triassic limestone and adjoining granitic rocks. Skarn orebodies include copper sulfides associated with magnetite or magnetite and hematite and with contact metamorphic silicate minerals.—*from* Authors' abstract

01736 **Morris, David Albert.** Lower Conemaugh (Pennsylvanian) depositional environments and paleogeography in the Appalachian Coal Basin [with] V. 2, Plates [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3754B, 1968.

02038 **Mosher, Loren Cameron.** Conodonts from the Triassic of western North America and Europe and their correlation [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4625B, 1968.

01962 **Mott, R. J.** A radiocarbon-dated marine algal bed of the Champlain Sea episode near Ottawa, Ontario: Canadian Jour. Earth Sci., v. 5, no. 2, p. 319–324, illus., tables, 1968.

A bed of marine algae (seaweed) in a sand pit in Champlain Sea sediments southwest of Ottawa, Ontario, was dated by the radiocarbon method and gave an age of 10,800±150 years (GSC-570). Marine shells from above and below the algal bed gave radiocarbon ages of 10,620±200 years (GSC-587) and 10,880±160years (GSC-588) respectively. The algae and underlying shells have been excellently preserved as a result of rapid burial following deposition and remaining beneath a high water table. The similarity of the radiocarbon dates on the algae and on the shells above and below, and with previous dates on shells from other Champlain Sea deposits indicates the reliability of these shell dates.—Author's abstract

07190 **Mottana, A.; Edgar, A. D.; Church, W. R.** Experimental studies on ariegites [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 302, 1967.

Mottana, A. *See* Edgar, A. D. 07205

07166 **Moyd, L.** Large nepheline and biotite crystals in calcite veins near Bancroft, Ontario [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 302–303, 1967.

Muehlberger, William R. *See* Bayley, Richard W. 01698

01695 **Muir, K. S.** Ground-water reconnaissance of the Santa Barbara-Montecito area, Santa Barbara County, California: U.S. Geol. Survey Water-Supply Paper 1859-A, p. A1–A28, illus., tables, geol. map, 1968.

The Santa Barbara-Montecito area is a low-lying flat section of the coastal plain; farther inland are highlands of consolidated rock and terrace deposits, the results of uplift, folding, and faulting. Most urban development is in the lowlands, which are structural depressions whose unconsolidated Pliocene to Recent formations make up the ground-water reservoir of the area. These deposits underlie an area of about 20 sq mi and have a maximum thickness of about 2,000 feet. Long-term perennial yield of the ground-water reservoir of the Santa Barbara area is estimated at 1,700–2,000 acre-feet, and of the Montecito area about 2,500. Most ground water is suitable for general use, but there has been some saline intrusion in nearshore shallow alluvial deposits.—*from* Author's abstract

01810 **Mull, D. S.; Pickering, R. J.** Water resources of the Middlesboro area, Kentucky: Kentucky Geol. Survey, ser. 10, Rept. Inv. 9, 51 p., illus., tables, geol. map, 1968.

The Middlesboro area has a dependable supply of high-quality surface water from an established reservoir in a protected drainage basin; owing to favorable geologic conditions, ample ground water is available also from sandstones and conglomerates of the Pennsylvanian Lee Formation where artesian wells can supply up to 100 gpm. Domestic and modest industrial supplies are available from shallower rocks of the Pennsylvanian Breathitt Group and domestic supplies from shallow alluvium. Abundant fractures about a unique circular depression of disturbed rocks in the Middlesboro basin have aided recharge and circulation of water in the aquifers; owing to the circulation, the quality of the ground water generally is satisfactory for most uses.—*from* Authors' abstract

01712 **Murray, D. Keith; Chronic, John; DeVoto, Richard H.; Madole, Richard F.** (compilers). Index of graduate theses and dissertations on Colorado geology by in-state institutions, 1905 through 1967: Mtn. Geologist, v. 5, no. 2, p. 45–67, 1968.

Students at institutions of higher learning in Colorado have, through 1967, produced 428 theses dealing with Colorado geology; 344 concern specific areas, while 84 are of a topical or regional nature. Most material in these theses has not been published; availability of all material is indicated. Part I is an alphabetical listing by author; part II is a cross index of all theses by institution; part II-A lists all areal theses by institution, year granted, and in alphabetical sequence within a given year; part II-B is an index of nonareal theses, first listed alphabetically by subject matter, then by institution.—MCM

01970 **Murray, J. W.; Macintosh, E. E.** Occurrence of interstratified glauconite–montmorillonoid pellets, Queen Charlotte Sound, British Columbia: Canadian Jour. Earth Sci., v. 5, no. 2, p. 243–247, illus., tables, 1968.

'Glauconite pellets', in bottom sediments of Queen Charlotte Sound on the British Columbia continental shelf, consist of interstratified glauconite–montmorillonoid and kaolin. Expansion of interstratified material to form a broad diffuse peak on glyceration reflects the presence of the montmorillonoid component. Potassium saturation followed by a series of heat treatments produced an asymmetrical 9.94 A peak. The clay fraction associated with the pellets was composed mainly of montmorillonoid with lesser kaolin and chlorite. The pellets may be either residual (eroded out of outcrops on the sea floor), relic Pleistocene, or Recent. It is suspected that this particular glauconite formed diagenetically from montmorillonoid by adsorption of K in interlamellar positions and possibly some substitution of Mg and Fe for Al in octahedral positions.—*from* Authors' abstract

Mursky, G. *See* Wanless, R. K. 01973

07170 **Nakaya, Ukichiro; Kuroiwa, Daisuke.** Physical properties and internal structure of Greenland snow, *in* Physics of snow and ice—Internat. Conf. on Low Temperature Science, Sapporo, Japan, 1966, Proc., V. 1, Pt. 2: Sapporo, Japan, Hokkaido University, p. 952–971, illus., 1967.

In order to study the relation between physical properties of snow and its internal structure, particularly in relation to the process of transformation of snow to ice, measurements were made of elastic modulus, permeability of air, and unconfined compression and creep on snow samples from Site 2 near Thule, Greenland. Thin section study of snow samples from the surface to 26 m in depth, showed that densification of snow proceeded by mechanical packing of grains in the initial stage of loading and developed by plastic deformation and recrystallization of grains in a later stage of compression.—VSN

02176 **Naldrett, A. J.; Mason, G. D.** Contrasting Archean ultramafic igneous bodies in Dundonald and Clergue Townships, Ontario: Canadian Jour. Earth Sci., v. 5, no. 1, p. 111–143, illus., tables, 1968; erratum, ibid., no. 2, p. 336, 1968.

A differentiated sill, 25 mi northeast of Timmins, may be classed as a stratiform intrusion, whereas several peridotite–pyroxenite lenses in the overlying pillow lavas have characteristics not reported previously. The sill differentiated to form a 1,000-ft basal layer of peridotite, 500 feet of augite pyroxenite, 700 feet of gabbro, and 200 feet of granophyric gabbro. The sequence is consistent with fractional crystallization models based on analogous experimental data. In the lenses, pyroxene-rich margins and bands are characterized by skeletal olivine and chromite crystals and acicular pyroxenes, indicating crystallization from a super-cooled liquid. The lenses may have been injected, while the volcanic sequence was still accumulating, as a mixture of olivine crystals and pyroxene liquid. Olivine was concentrated at the center while rapid chilling occurred at the margins.—*from* Authors' abstract

02039 **Nalewaik, Gerald Guy.** Petrology of the Upper Permian Cloud Chief Formation of western Oklahoma [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4626B, 1968.

Nation, J. B. *See* Hales, A. L. 02015

Nayudu, Y. R. *See* Dymond, J. R. 01941

01807 **Nelson, Arthur E.; Tobisch, Othmar T.** Geologic map of the Bayaney quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-525, scale 1:20,000, section, text, 1968.

The older rock sequence exposed in this quadrangle consists of 4,600 m of deformed Cretaceous to lower Tertiary volcanogenic deposits intruded by dioritic rocks; the younger sequence, resting unconformably on the older rocks, consists of about 550 m of undeformed middle Tertiary calcareous and associated deposits. A deep saprolite covers much of the bedrock. The Utuado pluton and minor stocks and dikes comprise the intrusive rocks. Parts of the older sequence have been hydrothermally altered and many original textures have been destroyed. Copper is the principal metallic mineral deposit, with some gold and silver. Nonmetallic resources include limestone, sand and gravel, and rock for various purposes.—MCM

01920 **Nelson, C. Hans; Kulm, L. D.; Carlson, Paul R.; Duncan, John R.** Mazama ash in the northeastern Pacific: Science, v. 161, no. 3836, p. 47–49, illus., 1968.

Volcanic glass in marine sediments off Oregon and Washington correlates with continental deposits of Mount Mazama ash by stratigraphic position, refractive index, and radiocarbon dating. Ash deposited in the abyssal regions by turbidity currents is used for tracing of the dispersal routes of postglacial sediments and for evaluation of marine sedimentary processes.—Authors' abstract

New Orleans Geological Society. *See* Lafayette Geological Society. 02121

01815 **Newman, Walter S.; Thurber, David L.; Krinsley, David H.; Sirkin, Leslie A.** The Pleistocene geology of the Montauk Peninsula, Trip F *in* Guidebook to field excursions—New York State Geol. Assoc., 40th Ann. Mtg., Flushing, N. Y., 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, p. 155–173, illus., 1968.

A brief description of the Pleistocene stratigraphy in this part of Long Island is followed by a road log for a field trip. The trip is over 152 miles long and makes 7 stops. An environmental analysis is made of the various units visited.—HRC

01924 **Newman, Walter S.; March, Stanley.** Littoral of the northeastern United States—Late Quaternary warping: Science, v. 160, no. 3832, p. 1110–1112, illus., table, 1968.

Isobases constructed from recently published data are strikingly parallel to both the edge of the continental shelf off the northeastern United States and the Fall Zone. The analyses suggest that the downwarping recorded by these isobases may be explained by Daly's hypothesis of a collapsing peripheral or marginal "bulge."—Authors' abstract

02179 **Newton, R.** Deriving contour maps from geological data: Canadian Jour. Earth Sci., v. 5, no. 1, p. 165–166, 1968.

A simple technique is presented for the derivation of contour maps from geological data. Nonsignificant discontinuities in the data are eliminated by the assumption of a spatial probability function, which ideally reflects the variation that would occur if extensive sampling were carried out over a small region. At the same time this 'smoothing' of the data produces a grid network of 'most probable' values over the map area, allowing the required isoplethes to be located.—Author's abstract

02156 **Nichols, P. H.; Peterson, G. E.; Wuestner, C. E.** Summary of subsurface geology of northeast Texas, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 982–1004, illus., 1968.

The basement of northeastern Texas is a complex of folded and faulted Paleozoic rocks; the overlying rocks are Upper Jurassic (Werner Formation) and younger. Between the basement and the Werner are red beds of uncertain age. In general, Mesozoic and Cenozoic strata dip and thicken toward the center of the northeast Texas area which has been divided into five provinces: updip belt, Mexia–Talco fault zone, downdip belt, Northeast Texas basin, and Sabine uplift. Gas and oil occur in structures in the Mexia–Talco fault zone. Salt-generated structures contain gas in the downdip belt and Northeast Texas basin. Gas accumulates in structural–stratigraphic traps around the Sabine uplift.—*from* Authors' abstract

01787 **Nigrini, Catherine; Nitecki, Matthew H.** Occurrence of Radiolaria in the Mississippian of Arkansas: Fieldiana—Geology, v. 16, no. 9, p. 255–268, illus., 1968.

Radiolaria are reported to be present in rocks of unquestionably Mississippian age in North America for the first time, as a part of a fauna consisting mainly of small siliceous fossils occurring in a calcareous concretion in the Fayetteville Shale of northern Arkansas. The specimens were found in the upper member of the Fayetteville Shale, stratigraphically approximate to the European Uppermost Visean. Both Spumellaria-like forms and members of the family Albaillellidae Deflandre, 1952, were found, although occurrences of the latter are rare. No taxonomic work has been attempted; the present authors wish only to report the occurrence and to give generalized descriptions of the forms encountered.—MST

Nitecki, Matthew H. *See* Nigrini, Catherine. 01787

01931 **Noble, Donald C.; Chipman, David W.; Giles, David L.** Peralkaline silicic volcanic rocks in northwestern Nevada: Science, v. 160, no. 3834, p. 1337–1338, illus., table, 1968.

Late Tertiary silicic ashflow tuffs and lavas peralkaline in chemical character (atomic Na + K greater than Al), mainly comendites, occur over wide areas in northwestern Nevada and appear to be widespread in southeastern Oregon. Such peralkaline rocks, which are not uncommon in the western United States, and other chemically unusual silicic rocks are found near the margins rather than toward the center of the Great Basin.—Authors' abstract

02140 **Nordquist, Jack W.; Leskela, Willard.** Natural gas in Sweetgrass arch area, northwestern Montana, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 736–759, illus., tables, 1968.

Twenty-four gas fields are mainly on the flanks of the Sweetgrass arch; most of the accumulation is in stratigraphic traps, but closures and faulting are controlling factors in some cases. The producing formations are: Sun River Dolomite (Mississippian), Sawtooth Formation (Jurassic), Swift Formation (Jurassic), Cut Bank Sandstone (Cretaceous), Sunburst Sandstone (Cretaceous), and Blackleaf Formation (Cretaceous); all are sandstones except the Sun River Dolomite. The Cretaceous rocks contribute over 90 percent of the gas production, and the Cut

Bank field accounts for over 70 percent of the gas in the area.—*from* Authors' abstract

01850 **Norgaard, Richard B.** Streamflow fluctuation, bar roughness, and bed load movement—A hypothesis: Water Resources Research, v. 4, no. 3, p. 647–650, illus., 1968.

A relation between streamflow variables and bar conditions on the Lower Columbia River derived by linear regression analysis on U.S. Army Corps of Engineer and U.S. Geological Survey data leads to the hypothesis that bed-load movement and bar scour are increased by streamflow fluctuation.—Author's abstract

02052 **Norris, Robert M.** Sea cliff retreat near Santa Barbara, California: California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 6, p. 87–91, illus., 1968.

Studies during the past five years along 10 miles of coast west of Santa Barbara show appreciable erosion at most points. A rocky cliff, 40 to 200 feet high, comprises this coast, with the Miocene Monterey Formation the oldest exposed. Near Goleta Point, in a syncline, the Sisquoc Formation and Pliocene Pico are exposed. Pleistocene and Recent terrace deposits cap the cliffs. Most of the cliff is subject to direct wave attack, subdued by a chain of islands to the south. Local factors influencing rate of retreat are spring sapping, corrasion, hydraulic pressure, and jointing of rocks. The rate of retreat, 3 to 10 inches per yr, was measured by comparing present and past positions of the cliff in relation to Geodetic Survey monuments. Trees, roads, storm sewers, and fences, close to the cliff, indicate similar figures.—ESL

01950 **Northrop, John; Loughridge, Michael S.; Werner, E. W.** Effect of near-source bottom conditions on long-range sound propagation in the ocean: Jour. Geophys. Research, v. 73, no. 12, p. 3905–3908, illus., 1968.

Underwater shots fired off Point Arena, California, were recorded on Sofar depth hydrophones at Eniwetok, Midway, and Oahu. Variations of 15 db in peak amplitude were noted on the records. The strongest signals were received from shots fired over the edge of the continental shelf in 90–275 m of water. Variations in observed signal level are attributed to changes in bottom slope, bottom material, and water depth in the source area.—Authors' abstract

01951 **Northrop, John.** Submarine topographic echoes from Chase V: Jour. Geophys. Research, v. 73, no. 12, p. 3909–3916, illus., 1968.

Hydroacoustic waves from the 1-kiloton Chase V shot detonated off Cape Mendocino, California, were recorded 240 km (150 mi) north of Hawaii on R. P. *Flip*. Reverberations were received for 2 1/2 hours after the direct arrival. Some of the prominent reflectors have been identified as the continental slope of North America, the Hawaiian arch, the Aleutian ridge, the Emperor seamounts, the Volshouki ridge, the Kurile Islands, and the Japanese Islands.—Author's abstract

Nota, D. J. G. *See* Emery, K. O. 01928

07291 **Nowacki, Werner; Edenharter, A.; Matsumoto, T.** Crystal data, systematic tables (2d edition): Pittsburgh, Pa., Polycrystal Book Service (Am. Crystallog. Assoc. Mon. 6), 195 p., 1967.

The basis for this statistical work is the second edition of Crystal data, Part 2, determinative tables (Donnay et al, 1963). In some cases, additional space-group determinations found in the literature are given. The number of compounds with known space groups has increased from about 3,800 to 8,800, and are here subdivided by composition into seven categories as in the first edition. The main table arranges these in the seven crystal systems, under each space group, according to category with formula, name if available, and reference to Part 2 for further data. Tables of statistical data give distribution of crystalline substances: among 219 space groups, 14 Bravais lattices, 32 crystal classes, 7 crystal systems; into symmorphic, hemisymmorphic, and asymmorphic space groups; and among the 43 most frequent space groups and among centric and acentric space groups.—GDC

01953 **Nydal, Reidar.** Further investigation on the transfer of radiocarbon in nature: Jour. Geophys. Research, v. 73, no. 12, p. 3617–3635, illus., tables, 1968.

This paper extends previous work (1967) on the transfer of radiocarbon in nature. The box model is expanded to include ten reservoirs: the stratosphere, troposphere, biosphere, mixed layer of the ocean, and the deep ocean in each hemisphere. Using some approximations, the various exchange coefficients have been calculated and more accurate values within the atmosphere have been obtained. The exchange time between the stratosphere and troposphere varies with time, and the recent result of 2.0 ± 0.5 yr is a better approximation for the first years after the radioactive injection than the previously reported value of 3.5 ± 0.8 yr. Using available C-14 data from the ocean, an attempt has been made to calculate the exchange time between the atmosphere and the mixed layer of the ocean. There seem to be valid reasons to believe that this exchange time is between 5 and 10 years.—Author's abstract

02147 **Oburn, Richard C.** North Park, Colorado—An oil and gas province, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 840–855, illus., tables, 1968.

North Park is the northernmost of two topographic basins that constitute a single intermontane structural basin in north-central Colorado. To date four commercial oil and gas fields have been developed in the northeast quadrant of the park. The predominant structural trend is west of north and is the result of a couple produced during Laramide orogeny. Later deformation in the late Miocene or early Pliocene was a result of north-south-oriented stresses. The first recorded deposition in North Park began in the Late Permian. This sedimentation was the beginning of a long sequence of marine and epicontinental deposition. Several excellent pay zones are found in the Mesozoic beds, especially those of Early Cretaceous age.—*from* Author's abstract

Oertle, D. H. *See* Radd, F. J. 02011

Off, T. *See* Dryden, J. E. 02104

02096 **Ogle, Burdette A.** Natural gas in Eel River basin, Humboldt County, California, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 68–75, illus., 1968.

The basin contains over 12,000 feet of rocks from Miocene to Recent age. Folding and thrust faulting in mid-Pleistocene time has formed the Eel River syncline with anticlinal folds on the north and south limbs and thrust faults on the northeast and east; these were later warped. The upper Pliocene Rio Dell Formation contains gas in two fields. Gas has been found also in the lower Pliocene Eel River Formation. Gas is trapped both by structures and stratigraphically. At Grizzly Bluff the nature of the trap is unknown, but it is probably stratigraphic on an anticlinal fold.—*from* Author's abstract

01898 **Ohle, Ernest L.** Copper mineralization in the upper part of the Copper Harbor Conglomerate at White Pine, Michigan—Discussion [of paper by S. K. Hamilton, 1967]: Econ. Geology, v. 63, no. 2, p. 190–191, 1968.

Hamilton's conclusion (ibid., v. 62, p. 885–904, 1967) that the native copper mineralization in sandstone is diagenetic does not take into account its spatial relationship to the White Pine fault. Furthermore, bitumen, with whose distribution the native copper correlates very closely, occurs in faults and cracks (i.e., it is post-deformation, at least in part) and also in the interstices of the sandstone in a manner reminiscent of typical heavy oil concentrations in sandstone. Bleaching associated with the copper may also be structurally controlled and post-date diagenesis.—WSW

02068 **Olesen, Ole B.** Ground temperature measurements in West Greenland, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 25–26, 1968.

Three stations for ground-temperature measurements, established during the summer of 1967, as part of the UNESCO International Hydrological Decade

program, are described. It is believed that the boundary between continuous and discontinuous permafrost lies in the quadrangle Holsteinsborg–Söndre Strömfjord–Christianshaab–Godhavn, and the stations are near the first two areas. Object of the program is to delimit permafrost areas both vertically and horizontally, and to study the influence of environmental factors.—ESL

Oliver, T. A. *See* Campbell, F. A. 01719

07247 **Olson, John P.** Why geologists should understand computers [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 284, 1967.

O'Neil, James R. *See* Rye, Robert O. 01914

Orr, J. B. B. *See* White, N. B. 02136

01737 **Orr, Robert William.** Conodonts from Middle Devonian strata of the Michigan basin [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3754B, 1968.

Osburn, W. H. *See* Wright, H. E., Jr. 02079

02108 **Osmond, John C.; Locke, Robert; Dillé, Alan C.; Praetorious, Walter; Wilkins, James G.** Natural gas in Uinta basin, Utah, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 174–198, illus., tables, 1968.

Three Tertiary formations, one Cretaceous group, and one Jurassic formation are capable of production in the Uinta basin; seven other formations of Cretaceous to Pennsylvanian ages produce nearby and, therefore, have an indicated gas potential in the basin. A long history of oscillating marine transgressions coupled with several tectonic episodes has produced many good reservoir rocks as well as potential source rocks in this area. Most of the gas accumulations discovered are in lenticular sandstone of Late Cretaceous and Tertiary ages. It is notable that the Tertiary strata are of lacustrine and fluviatile origin and the gas traps are almost entirely stratigraphic.—*from* Authors' abstract

01704 **Otto, David Arthur.** A study of the Middle Pennsylvanian flora found in Kansas coal balls [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3603B–3604B, 1968.

02141 **Paape, Donald W.** Geology of Wind River basin of Wyoming and its relationship to natural gas accumulation, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 760–779, illus., tables, 1968.

The marine Cretaceous Cody Shale in the Wind River basin is overlain with intertonguing by the Cretaceous Mesa Verde Formation; the next overlying Lewis Shale and Meteetse Formation also intertongue. The overlying Paleocene Fort Union Formation is primarily terrestrial but the upper part contains the Waltman Shale which is lacustrine or restricted marine in origin. From Paleocene to Pliocene time the basin was filled with clastic material from the bordering mountains, but an exhuming process, still in progress, began in post–Pliocene time. The Laramide structural features influenced contemporaneous patterns of deposition in the basin. Thrusting on the east and north flanks followed the Laramide in earliest Eocene, and some later, superficial deformation is also recorded. Natural gas is present.—*from* Author's abstract

07202 **Pablo, L. de.** Electron microscopy and diffraction of kaolinitic clays [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 287, 1967.

01947 **Page, Robert.** Focal depths of aftershocks: Jour. Geophys. Research, v. 73, no. 12, p. 3897–3903, illus., table, 1968.

A review of aftershock studies that feature accurate determinations of focal depths leads to the conclusion that prominent, well-defined aftershock sequences occur only at shallow depths, less than about 20 km. Data currently available from various

geographic and tectonic regions throughout the world indicate that the occurrence of aftershocks is confined to the Earth's crust, and often to the upper layers of the crust, regardless of the magnitude of the main shock. This observation is important to our understanding of the aftershock process and the physical properties of the material in the Earth's crust.—Author's abstract

Papike, J. J. *See* Coleman, R. G. 01932

Parissis, C. *See* VanLoon, J. C. 01828

Parker, Patrick L. *See* Calder, John A. 01774

Parsons, Roger B. *See* Balster, Clifford A. 01691

Passwater, Barbara G. *See* Passwater, Richard A. 07292

07292 **Passwater, Richard A.; Bennett, Jarratt G.; Passwater, Barbara G.** Guide to fluorescence literature: New York, Plenum Press Data Div., 367 p., 1967.

A recent survey showed that 22 percent of all chemical and clinical research was unintentionally duplicated, hence the need for a comprehensive source book of fluorescence and phosphorescence techniques. The 4,800 papers (1950–64) listed in this volume represent only a fraction of those considered, the criterion for inclusion being the presence of substantial pertinent information, or because the methods seem to have an unusual potential for the problems discussed. It is hoped that this compilation will prevent not only needless duplication, but also suggest new ideas for future research among analytical chemists, biochemists, medical researchers, physicists, and inorganic chemists.—GDC

01891 **Paterson, M. S.; Weiss, L. E.** Folding and boudinage of quartz-rich layers in experimentally deformed phyllite: Geol. Soc. America Bull., v. 79, no. 7, p. 795–812, illus., 1968.

In deformation experiments at 5 kb confining pressure and room temperature, quartz-rich layers in phyllite develop structures such as folds, faults, and boudins during the growth of a pattern of intersecting kinks in the phyllitic matrix. Layers containing appreciable amounts of mica and having a foliation like that in the matrix follow the deformation of the matrix fairly closely. In layers of massive pure quartz, folding appears to be initiated by the kinking in the matrix, but it develops in a nearly independent way, giving rise to a change in style of the folds with progressive deformation. The isotropic cataclastic behavior of the quartz, at least in the early stages, is associated with nearly passive response of the layers to the stability of the anisotropic matrix.—RAL

Patton, W. W., Jr. *See* Gates, George O. 02094

01809 **Patton, William W., Jr.; Miller, Thomas P.; Tailleur, Irvin L.** Regional geologic map of the Shungnak and southern part of the Ambler River quadrangles, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-554, scale 1:250,000, 1968.

07165 **Paulitsch, P.** Results of petrofabric analysis by an X-ray universal stage [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 303, 1967.

02081 **Payne, J. N.** Hydrologic significance of the lithofacies of the Sparta Sand in Arkansas, Louisiana, Mississippi, and Texas: U.S. Geol. Survey Prof. Paper 569-A, p. A1–A17, illus., table, 1968.

Thicker sections of the Sparta Sand lie along the axes of the Mississippi embayment and Desha basin; local thickening or thinning indicates structural movement during Sparta time. A sand-percentage map indicates the Sparta Sand was deposited as a delta-fluvial plain complex in Arkansas, Louisiana, and Mississippi; in most of Texas the pattern is suggestive of offshore or near-shore bar deposition. Coefficients of permeability and transmissibility vary widely in localized areas. Recharge is by infiltration of water from precipitation on the outcrop, leakage from other aquifers, and seepage from streams; discharge is by leakage through confining beds. Areas

of higher transmissibility have lower concentrations of dissolved solids than areas of low transmissibility; differences in water chemistry are attributed to regional differences in rates of ground-water movement.—*from* Author's abstract

01959 **Payne, John G.** Geology and geochemistry of the Blue Mountain nepheline syenite: Canadian Jour. Earth Sci., v. 5, no. 2, p. 259–274, illus., tables, 1968.

The Blue Mountain nepheline syenite sill formed from a nepheline syenite magma that intruded metasediments and syenite gneiss about 1,300 m.y. ago. The magma was fractionated during emplacement into several zones, distinguished by their chemistry, mineralogy, and texture. Pegmatites were formed from late-stage fluids. Mafic bodies in the sill represent slabs of metasediments stoped from the roof of the sill by the magma, and strung out into narrow sheets. A contact aureole was developed above and to a minor extent below the sill; alkalies, alumina, water, and carbon dioxide were added to the metasediments from the magma. The sill and surrounding rocks were folded into their present positions during the Grenville orogeny about 1000 m.y. ago.—*from* Author's abstract

Pearson, F. J. *See* Perlmutter, N. M. 01818

01804 **Pease, Maurice H., Jr.** Geologic map of the Aguas Buenas quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-479, scale 1:20,000, section, text, 1968.

Stratified rocks south of the Cerro Mula fault are mainly the Cretaceous Rio Orocovis Group; north of the fault they consist of ten Cretaceous and Tertiary formations. Intrusive rocks are Cretaceous-Tertiary granodiorite, quartz diorite, hornblende porphyry, and diabase; metamorphic rocks are hydrothermally altered rocks and amphibole schist of the above ages. Unconsolidated materials are Quaternary terrace, landslide, and alluvial deposits. Sulfide minerals include copper sulfides, molybdenite, and traces of gold and silver. Nonmetallic minerals are sand and gravel, crushed stone, lightweight aggregate, limestone, fill, and clays.—MCM

01805 **Pease, Maurice H., Jr.** Geologic map of the Naranjito quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-508, scale 1:20,000, sections, text, 1968.

Most of the Naranjito quadrangle is underlain by a sequence of interfingering lava and marine and nonmarine pyroclastic and tuffaceous sedimentary rocks more than 13,000 m thick, and ranging in age from Early(?) Cretaceous to early Eocene(?); they unconformably underlie about 160 m of Oligocene and Miocene calcareous epiclastic rocks exposed along the northern border. Intrusive rocks are andesite, a keratophyric dike, quartz diorite, pyroxene diorite, and hydrothermally altered rock. Dominant structures are WNW- to NW-trending wrench faults which have sliced through a southward dipping monoclinal sequence. Locations of faults are based chiefly on indirect evidence. Resources of economic interest include copper, barite, gold, and crushed rock and gravel.—MCM

01864 **Pedersen, K. Raunsgaard.** Fossils of Precambrian age from South-West Greenland, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 51–53, 1968.

Some areas in the Ketilidian fold belt are only slightly metamorphosed and contain macro- and microfossil structures. In southern Graenseland, tube-formed structures were found in a yellow dolomite in the basal Ketilidian and suggest that the Graensesö Formation should be referred to the lower Zig Zag Land Formation. A microspherical structure was also found in the Zig Zag. A globular structure is found in great numbers in the Rendesten Formation. *Vallenia erlingi*, described from the northern Graenseland area, is not found in the south. A Ketilidian succession in the Arsuk basin, correlated with formations in the Graenseland area, has yielded microfossils.—ESL

02064 **Pedersen, K. Raunsgaard.** Angiospermous leaves from the Lower Cretaceous Kome Formation of northern West Greenland, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 17–18, 1968.

The limnic Kome Formation occurs on the north side of Nûgssuaq Peninsula. Shales, coal seams, and sandstones rest on weathered Precambrian gneiss, and are overlain unconformably by another limnic formation. Earlier reports of angiosperms in the Kome having been discredited, the age is in doubt. An extensive collection for spore and pollen analysis and of macrofossils has revealed a few angiosperm leaves in situ. A full investigation is in progress.—ESL

02085 **Pemberton, H. Earl; Bideaux, Richard A.** An occurrence of svanbergite in California: Mineral Explorer, v. 3, no. 1, p. 11, 1968.

This basic sulfate-phosphate of strontium and aluminum has been identified as a minor constituent of the kyanite deposit in the Vitrefax formation of the Cargo Muchacho Mts., Imperial County. It was found in a pyrophyllite lens in a section of the more quartzose parts of this muscovite schist formation, apparently a hydrothermal concentration of quartz and kyanite. Pyrophyllite is not common in the Bluebird Hill area where this lens was found; the association of svanbergite with it and kyanite parallels its first reported occurrence in Sweden. Closely associated minerals are strontium barite and rutile, and minor amounts of tourmaline, carnotite, and a pale bluish clay mineral. X-ray fluorescence showed major Sr and P in svanbergite, with no Ba, Pb and As; the barite contains only a little Sr and no Pb.—GDC

01696 **Perkins, H. F.; Ritchie, F. T., Jr.** Physical features of Georgia: Jour. Soil and Water Conserv., v. 23, no. 3, p. 97–100, illus., 1968.

Geomorphic features, major soils and their parent rocks, climate and land use are summarized briefly for the eight major land resource areas of Georgia.—VMJ

01818 **Perlmutter, N. M.; Pearson, F. J.; Bennett, G. D.** Deep-well injection of treated waste water—An experiment in re-use of ground-water in western Long Island, N.Y., Trip I *in* Guidebook to field excursions—New York State Geol. Assoc., 40th Ann. Mtg., Flushing, N. Y., 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, p. 221–231, illus., table, 1968.

The fresh ground water of the area is bordered by and is hydraulically connected with salty ground water which in turn is hydraulically connected with bodies of salty surface water in estuaries, bays, etc. The salty ground water, a near- and a long-term threat, is locally encroaching in the Jameco and Magothy aquifers as a wedge. Artificial recharge experiments in the area for waste materials have application to artificial recharge of fresh water in the Magothy aquifer to stabilize the encroaching salt-water wedge. A summary of the hydrogeology of western Long Island and the characteristics of the wedge are reviewed as background for understanding the design and operation of the injection study and its possible relation to the problem of regional salt-water encroachment.—*from* Authors' introduction

01854 **Petersen, G. W.; Cunningham, R. L.; Matelski, R. P.** Moisture characteristics of Pennsylvania soils—[Pt.] 1, Moisture retention as related to texture: Soil Sci. Soc. America Proc., v. 32, no. 2, p. 271–275, illus., tables, 1968.

Average moisture contents at 1/3 and 15 atm levels and available moisture for various soil textural classes in Pennsylvania were determined from 1,267 surface and subsoil samples. Multiple regression analyses showed core bulk density most strongly associated with 1/3 atm moisture, <2 mm sieved clay content with 15 atm moisture; and organic carbon also with 15 but not with 1/3 atm moisture. Available moisture correlated negatively with sand and clay, positively with silt content; it was also highly correlated with 1/3 atm moisture whereas 15 atm moisture showed either negative or no correlation. Scatter diagrams show predictability from clay percentages. Equations for estimating available moisture from predetermined soil properties are given for each USDA textural class, except sand and sandy clay, and for each textural class of the new family grouping.—GDC

Peterson, Dean F., Jr. *See* Thomas, Harold E. 07287

Peterson, G. E. *See* Nichols, P. H. 02156

Pettijohn, F. J. *See* James, H. L. 01692

Pickering, R. J. *See* Mull, D. S. 01810

Pierce, Robert S. *See* Johnson, Noye M. 01984

02014 **Pokrzywnicki, Jerzy.** Kolekcja meteoritów Institutu Meteorytyki Uniwersytety w New Mexico [with Russian and French summ.]: Acta Geophys. Polonica, v. 16, no. 1, p. 117–122, illus., 1968.

After a brief general description of the University of New Mexico's meteorite collection, some of the more interesting specimens are discussed, particularly Norton County. In conclusion, attention is drawn to the fact that it is impossible to apply the Bresina law absolutely rigorously in all cases of falls or finds; in cases where the name of the locality has been changed or where the fall actually is found to have occurred elsewhere, the old name should be given in parentheses on the label.—DBV

01717 **Potter, Paul Edwin.** A selective, annotated bibliography on carbonate rocks: Bull. Canadian Petroleum Geology, v. 16, no. 1, p. 87–103, 1968.

The object of this bibliography is to provide a starting point in bibliographic research on carbonates from almost every possible viewpoint—not only origin and diagenetic changes, but also the role they play in such diverse fields as geomorphology, petroleum, ground water, and mineral deposits; only purely igneous, paleontologic, and biomineralogical studies are excluded. The bibliography has a definite sedimentary bias. References are grouped into: general, petrography and sedimentation, geochemistry, ecology and paleoecology, porosity and petrophysics, geomorphology and weathering, hydrology, carbonates as hosts for mineralization, uses, and bibliography.—MCM

07255 **Potts, Raymond H.** The deposition environments of the Spiro Sands in the Arkoma basin [abs.]: Tulsa Geol. Soc. Digest, v. 35, p. 289, 1967.

Powers, Howard A. *See* Macdonald, Gordon A. 02001

Praetorious, Walter. *See* Osmond, John C. 02108

Pray, Lloyd C. *See* Kottlowski, Frank E. 07278

01929 **Press, Frank.** Density distribution in Earth: Science, v. 160, no. 3833, p. 1218–1221, illus., table, 1968.

Earth models selected by a Monte Carlo procedure were tested against geophysical data; 5 million models were examined and six have passed all tests. Common features of successful models are an increased core radius and a chemically inhomogeneous core consistent with Fe–Ni alloy (20–50 percent Fe) for the solid portion and Fe–Si alloy (15–25 percent Fe) for the fluid core. The inhomogeneous mantle is consistent with an increase in the FeO:FeO + MgO ratio by a factor of 2 in the deep mantle. The transition zone is a region of not only phase change but also composition change; this condition would inhibit mantle-wide convection. The upper-mantle solutions show large fluctuations in density; this state implies insufficient constraint on solutions for this region, or lateral variations in mantle composition ranging from pyrolite to eclogite.—Author's abstract

01827 **Prest, V. K.; Grant, D. R.; Rampton, V. N.** (compilers). Glacial map of Canada: Canada Geol. Survey Map 1253A, scale 1:5,000,000, 1968.

The reverse side of the sheet contains an index map with references grouped by province. References are those used directly in preparation of the map or that served as a guide for airphoto interpretive work; they are not intended as a comprehensive coverage of the Pleistocene of Canada. The map is based on all

known information available to the end of 1965 but includes also some data obtained in 1966 and early 1967.—MCM

Pulvertaft, T. C. R. *See* Escher, A. 02062

07173 **Pytkowicz, Ricardo Marcos; Fowler, Gerald Allan.** Solubility of foraminifera in seawater at high pressures: Geochem. Jour., v. 1, no. 4, p. 169–182, illus., tables, 1967.

In situ pH electrodes were used to show that solution of pelagic calcareous foraminifera occurs in sea water at pressures between 100 and 1,000 atm. Results confirm earlier work which had indicated that carbonate compensation depth is not a boundary between super- and under-saturated waters. The degree of solution and hence diagenetic alterations which may affect the geologic record were found to depend on the calcareous species. Physicochemical knowledge on the effect of pressure on carbonate ion pairs, on relative solubilities of calcite and aragonite, and on rates of solution were yielded also. There is no solubility in the thermodynamic sense but this is shown not to affect the value of solubility measurements for oceanographic and geochemical work.—*from* Authors' abstract

01840 **Raats, P. A. C.; Klute, A.** Transport in soils—The balance of mass: Soil Sci. Soc. America Proc., v. 32, no. 2, p. 161–166, 1968.

A treatment of transport in soils, based upon a continuum theory of mixtures, is proposed. Some of the general features of this theory and its application to soils are discussed. A soil is regarded as a mixture of phases, e.g., an unsaturated soil is regarded as a mixture of a solid phase, an aqueous phase, and a gaseous phase. The idea of balance of mass is considered in some detail, in particular in relation to deformable soils. The integral balance of mass for a certain phase over a certain volume is formulated. From the integral balance of mass differential forms are deduced. The balance of mass for water in a deformable soil is derived. Under special circumstances this balance of mass reduces to special forms that appear in the literature.—*from* Authors' abstract

02011 **Radd, F. J.; Oertle, D. H.** Melting point behaviour of glacier ice: Nature, v. 218, no. 5148, p. 1242, illus., 1968.

The data suggest that the melting points at the base, along the sides, and on the length of a glacier are variable and depend on the local pressures exerted at any given point. Derivative X-ray evidence showed that pressurized ice contains several residual stresses and little preferred orientation.—KAS

Rampton, V. N. *See* Prest, V. K. 01827

01817 **Ratcliffe, Nicholas M.** Stratigraphic and structural relations along the western border of the Cortlandt intrusives, Trip H *in* Guidebook to field excursions—New York State Geol. Assoc., 40th Ann. Mtg., Flushing, N. Y., 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, p. 197–220, illus., 1968.

A field trip focusing on the problem of the correlation of the Manhattan Schist and Inwood Marble south of the Cortlandt intrusives is described. Lithic and structural arguments are presented to support correlation of these rocks with the fossiliferous rocks at Tomkins Cove and Verplanck Point. The various units involved are described in detail, and unconformities and structural relations are discussed. The road log for a field trip is 38 miles long and makes 7 stops.—HRC

01905 **Ratcliffe, Nicholas M.** Contact relations of the Cortlandt complex at Stony Point, New York, and their regional implications: Geol. Soc. America Bull., v. 79, no. 6, p. 777–786, illus., tables, 1968.

Two plutons of the Cortlandt complex cut foliated folded rocks of probable Cambrian–Ordovician age at Stony Point. Structures in the deformed rocks are truncated by the earliest pluton and a later pluton cuts both the early pluton and enclosing rocks. Intrusive relations, contact metamorphism, and lack of deformed igneous contacts indicate that the main deformation in this area preceded intrusion

of the plutons. K–Ar age determinations on the intrusives and other data show that deformation in the country rocks resulted from Taconic instead of Acadian orogenesis.—EHP

01983 **Raymahashay, Bikash C.** A geochemical study of rock alteration by hot springs in the Paint Pot Hill area, Yellowstone Park: Geochim. et Cosmochim. Acta, v. 32, no. 5, p. 499–522, illus., tables, 1968.

The rhyolitic country rocks in two thermal areas in Yellowstone Park have been extensively altered by waters of two major types of hot springs: the acid sulfate springs and mud–pots, and the alkaline Na–Cl–HCO_3 springs and geysers. At the acid springs near–surface oxidation of effluent sulfur gases produces sulfuric acid which attacks the rocks and produces an assemblage of kaolinite, alunite and silica minerals. The compositions of all the acid springs plot in the thermodynamic stability field of alunite in the corresponding temperature range. The alkaline springs are lined with thick deposits of silica obscuring any alteration of the wall rock. Their analyses plot in the field of stability of an idealized Na–montmorillonite phase between 25° and 95°C.—KAS

Raymond, Michael. *See* Hafner, Stefan. 07234

07311 **Raymond, Walter B., 3d.** Sand size relations along Cullasaja River near Franklin, N. C. [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 4, p. 341, 1967.

01701 **Redden, Jack A.** Geology of the Berne quadrangle, Black Hills, South Dakota: U.S. Geol. Survey Prof. Paper 297–F, p. 343–408, illus., tables, geol. maps, 1968.

In the Berne quadrangle Precambrian medium– to high–grade metamorphic rocks and pegmatites are unconformably overlain by small areas of Paleozoic sedimentary rocks. Five formations of metamorphic rocks are separated by a major fault from four additional lithologic units. Some 1,150 bodies of pegmatite are classified into four types based on their internal structures. Three distinct sets of folds and related structures indicate multiple or complex deformation(s) and result in complex structural patterns ranging from isoclinal folds to broad domes. Mineral assemblages and relict textures indicate both regional and thermal metamorphism. Metasomatism occurred during emplacement of pegmatite. Sheet and scrap mica, feldspar, beryl, and lithium minerals have been produced from the pegmatite deposits and gold from quartz veins and placers.—JAR

01709 **Reed, Bruce L.; Elliott, Raymond L.** Geochemical anomalies and metalliferous deposits between Windy Fork and Post River, southern Alaska Range: U.S. Geol. Survey Circ. 569, 22 p., illus., tables, 1968.

Geochemical sampling between Windy Fork and Post River, southern Alaska Range, defines seven areas with anomalous concentrations of lead, zinc, silver, copper, or molybdenum in stream–sediment samples. Five of these areas contain metalliferous deposits that are spatially related to centers of hypabyssal igneous bodies. The deposits occur as replacement bodies in limestone and as replacement bodies and fracture fillings in intrusive rocks. Most of the deposits that crop out are small and discontinuous, but the number of occurrences with locally high silver content, their possible continuity beneath surficial deposits, and a favorable geologic environment suggest that this region has an economic potential for base and precious metals.—Authors' abstract

02125 **Reedy, R. D.** Introduction to geology of gas occurrence in Sacramento Valley, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 610, 1968.

Dry gas is found in rocks of Pliocene, Eocene, and Late Cretaceous ages, which constitute a maximum stratigraphic thickness of more than 50,000 feet near the south–central Sacramento Valley, or Rio Vista portion of the basin. The mode of gas entrapment is extremely varied, although most of the purely structural traps are in the southern part. Faults and domes have trapped two–thirds of the reserves in the valley. Northward the traps are more complex because of the extreme

irregularly in the Cretaceous F-zone sandstone distribution. The Maryville Butte volcanic area has some traps in Cretaceous rocks also.—HRC

02144 **Reese, Douglas L.** Gas fields of Rock Springs uplift, Sweetwater County, Wyoming, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 803–816, illus., tables, 1968.

Seven gas fields have been developed on the Rock Springs uplift in southwestern Wyoming—North Baxter Basin, Middle Baxter Basin, South Baxter Basin, Little Worm Creek, Joyce Creek, Salt Wells, and Nitchie Gulch. Production from these fields has amounted to 214 billion cu ft of gas from the Frontier, Dakota, and Morrison Formations, and the Nugget Sandstone. Minor oil production has been established from the Dakota Formation at Joyce Creek and the Morrison Formation at Little Worm Creek. Most of these fields have prospects of additional gas in untested fault blocks and new zones in the deeper Paleozoic formations. Remaining proved reserves are estimated to be 102 billion cu ft of gas. Hydrothermal alteration possibly may explain areal variations in the composition of gas found in certain formations.—Author's abstract

01974 **Reinhardt, E. W.** Phase relations in cordierite-bearing gneisses from the Gananoque area, Ontario: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 455–482, illus., tables, 1968.

Phase relations among sillimanite, cordierite, garnet, biotite, and hypersthene from regionally metamorphosed pelitic gneisses were determined from petrographic studies and chemical compositions of 46 ferromagnesian minerals and 18 bulk rocks. The conclusions of the author are based on the application of triangular *AFM* diagrams to the cordierite-bearing mineral assemblages of the Gananoque area, which permit a more fundamental understanding of the regional metamorphism of pelitic rocks.—MST

01980 **Remo, J. L.; Skalafuris, A. J.** A physical model for tektites of meteoritic origin: Jour. Geophys. Research, v. 73, no. 12, p. 3727–3735, illus., tables, 1968.

A phenomenological study is made of the formation of tektites from a meteorite impacting on the Earth. The calculation shows that, if the meteorite that caused the Ries Kessel crater ejected large fragments from the parent meteorite at speeds of about 18 kmps, these particles would interact with the terrestrial ejecta at the start of the recoil trajectory. A hypersonic ablation calculation at 18 kmps is made for a single large fragment by extrapolating H. Hoshizaki's (1962) model for the heat transfer rate at an axisymmetric stagnation point. The results of these calculations show that this physical model can yield the size and distribution of the tektite field being considered and can also account for many of the various tektite characteristics. The analysis in this paper is limited only to observations; thus, all refinements that do not clarify the basic physical model have been ignored.—Authors' abstract

07316 **Reyment, Richard A.** Paleoethology and fossil drilling gastropods: Kansas Acad. Sci. Trans., v. 70, no. 1, p. 33–59, illus., tables, 1967.

The concept of paleoethology is defined, in the present connection, as interpreting the attack behavior of drills, based on an analysis of the location and nature of drill holes. Paleogene ostracods from the subsurface, and living ostracods and mollusks from the western Niger delta (Africa) are studied. Statistically, it is possible to identify the gastropod which drilled the holes in the shells. Valve preference is shown by naticids in drilling pelecypods but not ostracods. The Muricidae and Naticidae are active predators of pelecypods, gastropods, scaphopods, and ostracods. Naticids seek only living prey in the upper layers of the sediments, whereas muricids search only the surface of the sediment but will also eat carrion.—*from* Author's abstract

02050 **Richard, Pierre.** Un spectre pollinique type de la sapinière à bouleau blanc pour la foret Montmorency [with English abs.]: Naturaliste Canadien, v. 95, no. 2, p. 565–576, illus., tables, 1968.

The pollen rain of Montmorency Experimental Forest, 50 miles north of Quebec City, was studied during the summer of 1966. The forest is in the basalm fir–white birch climax domain. Analyses of pollen and spores trapped in sphagnum moss cushions were compared with a local and regional phytosociological survey of the vegetation. A type pollen spectrum was established for Montmorency forest, based on interpretation of tree pollen as representing the regional forest vegetation, and nonarboreal pollen and spores as reflecting local differences in vegetation. This study indicates the possibility of defining the vegetation of each climax domain by means of type pollen spectra. A succession of such type spectra would allow interpretation of pollen analyses of postglacial peats on an ecological basis.—VMJ

Richards, Paul G. *See* Teng, Ta-Liang. 02016

01930 **Rieder, Milan.** Zinnwaldite—Octahedral ordering in lithium-iron micas: Science, v. 160, no. 3834, p. 1338–1340, illus., 1968.

Ordering of the octahedral sheet of some lithium-iron micas is proposed on the basis of chemical compositions and crystallographic properties. The model of the ordered sheet has large and small sites in the ratio 2:1 and explains all observed properties: the small layer thickness, the "dioctahedral reflections," and the n(120 deg) motif in polytypism.—Author's abstract

07167 **Rimsaite, J.** Studies of micas from uncommon rocks—[Pt.] 1, Micas from nepheline syenite, Blue Mountain, Ontario, and from carbonatite, Oka, Quebec [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 304, 1967.

Ritchie, F. T., Jr. *See* Perkins, H. F. 01696

07282 **Ritchot, Gilles.** Problèmes géomorphologiques du Québec méridional—Pts. 1-2, Le mont Royal, esquisse géomorphologique [with English abs.]: Rev. Géographie Montréal, v. 21, no. 1, p. 41–79, illus., 1967; ibid., no. 2, p. 267–311, illus., 1967.

Mount Royal, a residual massif, rises eastward to an elevation of 200 m overlooking the Montreal platform. Hard rock cores frame slope knobs that dot the step-faulted piedmont. The cores of two inselbergs flanking the south margin cut metamorphic limestones of Paleozoic age. As a whole, the crystalline rocks resisted the neotectonic foldings of the surrounding limestones, but a spur was dislocated by a Pliocene monoclinal flexure which deformed the eastern part of the Island of Montreal. The neotectonic massif has been deeply weathered, its relict soils denoting subarid Pliocene climate. Old inset pediments lie on the western slope, which was remodeled by Pleistocene glaciers. Periglacial processes have shaped altiplanation terraces on the eastern piedmont.—GDC

02145 **Ritzma, Howard R.** Geology and occurrence of gas, Wamsutter arch, Sweetwater County, Wyoming, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 817–827, illus., tables, 1968.

The Wamsutter arch, an eastern extension of the Rock Springs uplift, is a gently-plunging nose separating the Washakie and Red Desert basins. In this area Late Cretaceous intertonguing of marine shale and nonmarine sandstone produced the reservoir sandstones which are in the transition zone between the nonmarine Mesa Verde (Almond) and marine Lewis Shale. The arch was formed during latest Cretaceous and Paleocene time. A northeastern extension of this uplift, the Table Rock Platform, is very productive. Beds on the platform thicken markedly toward the east. The folding of the Wamsutter arch and the Rock Springs uplift occurred during late Eocene and Oligocene time, and perhaps extended into the Pleistocene. The resulting eastward tilt has masked the older structures and caused significant updip migration.—*from* Author's abstract

Roberts, J. *See* Hales, A. L. 01946

01769 **Robertson, J. A.** Geology of Township 149 and Township 150: Ontario Dept. Mines Geol. Rept. 57, 162 p., illus., tables, geol. maps, 1968.

The map-area is located in the Elliot Lake sector of the Blind River uranium district. Production in the district through 1965 was over one million dollars, two-thirds of which came from nine mines in the map-area. Huronian sediments were deposited on a peneplane underlain by volcanic rocks intruded by Algoman granitic rocks. The Bruce Group is overlain unconformably by the Cobalt Group, and all are folded about a synclinal axis. Fractures and joints developed, and thrust faults are found on the north limb; steeply dipping faults may be wrench, normal, or reverse and are grouped according to strike. Uranium occurs in basal conglomerate of the Lower Mississagi Formation. The Quirk ore zone is on the north limb of the syncline in T. 150, and the Nordic zone on the south limb in T. 149; main minerals are uraninite, brannerite, and monazite. The deposits are believed to be syngenetic, with late modification.—ESL

Robertson, W.A. *See* Roy, J. L. 01960

01831 **Rodgers, John.** Nekotoryye voprosy tektoniki Appalachey [with English summ.]: Geotektonika 1968, no. 3, p. 3–29, illus., 1968.

Some important facts in the history of the Paleozoic geosynclinal and orogenic belt recorded in the Appalachian Mountains are still unclear. The isolated folds and thrust faults of the Appalachian Plateau and the closely spaced folds and thrusts of the Valley and Ridge Province are all thought to be marginal effects of compression and uplift of the Blue Ridge and Piedmont Provinces. The Taconic slate and similar masses are probably detached masses that slid by gravity from uplifted anticlinoriums into the Ordovician sea. The interior metamorphic provinces are now considered to be mainly Paleozoic. The Appalachian orogeny is an integral part of the geosynclinal history. Movements began soon after the beginning of geosynclinal deposition and continued intermittently throughout the Paleozoic; no one period can be considered the culminating orogeny for the whole system.—DBV

07168 **Roedder, E.** Temperature and salinity of the ore-forming fluids at Pine Point, Northwest Territories, Canada, from fluid inclusion studies [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 304–305, 1967.

01803 **Roen, John B.; Kent, Bion H.; Schweinfurth, Stanley P.** Geologic map of the Monongahela quadrangle, southwestern Pennsylvania: U.S. Geol. Survey Geol. Quad. Map GQ-743, scale 1:24,000, section, text, 1968.

The Pittsburgh, Redstone, and Waynesburg are the commercially important coal beds in the Monongahela quadrangle. Since 1887 natural gas has been produced from subsurface sandstone beds of Mississippian and Devonian age. Limestone has been quarried in small amounts, mainly from the Sewickley Member of the Pittsburgh Formation for road metal and agricultural lime, but large amounts of silica, magnesium, and clay minerals in this and in other limestone units restrict any extensive use. Clay and shale in the Redstone Member of the Pittsburgh have been used for brick manufacture; both are widely distributed and are a potential source of raw material for brick and lightweight aggregate. Sandstone, quarried on a small scale, is limited economically because of its friability and high clay content.—MCM

02160 **Rogers, Robert E.** Carthage field, Panola County, Texas, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 1020–1059, illus., tables, 1968.

Structurally, Carthage field is a broad, low-relief terrace on a regional plunging anticline at the southwest end of the Sabine uplift. Over 90 percent of the production comes from the Pettet Formation and the remainder from the Rodessa, Travis Peak, upper Glen Rose, and Paluxy Formations. Gas in the limestones is controlled by structure and by belts of interfingering porous and permeable rocks. There is a direct relation to the oolites and hydrocarbons. Gas in the sandstone is trapped in part by lenticularity and erratic distribution of reservoir beds; however, the areal distribution of accumulation tends to conform to the elongate limestone trends.—*from* Author's abstract

02040 **Rona, Peter Arnold.** A seismic and sedimentological investigation of the continental terrace, continental rise, and abyssal plain off Cape Hatteras, North Carolina [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4626B, 1968.

01757 **Rooney, Thomas Peter.** Mineralogical study of North Carolina phosphorite [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4220B–4221B, 1968.

Rosenbaum, C. *See* Klein, E. 07196

07227 **Rosenberg, P. E.** Variations in the unit-cell dimensions of topaz and their significance: Am. Mineralogist, v. 52, nos. 11–12, p. 1890–1895, illus., tables, 1967.

A study of variations in the unit-cell dimensions of 14 topaz samples indicates that the *b* dimension of topaz increases progressively with substitution of OH^- for F^-.—MEM

02010 **Ross, David A.** Current action in a submarine canyon: Nature, v. 218, no. 5148, p. 1242–1245, illus., 1968.

Observations of ripple marks, scour marks and exposed boulders on the Corsair Canyon (320 km east of Cape Cod, Mass.) floor indicate that bottom currents, considerably stronger than the 0.1 knot current observed, have existed at a depth of at least 1600 m. Abundant fish and invertebrate life were observed in all parts of the canyon, while sessile organisms were rare in the canyon bottom.—KAS

07299 **Rossman, William H., Jr.** The study of crystalline models using sonic techniques [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 3, p. 239–240, 1967.

Rowland, T. L. *See* Amsden, Thomas W. 07280

01960 **Roy, J. L.; Robertson, W. A.** Evidence for diagenetic remanent magnetization in the Maringouin Formation: Canadian Jour. Earth Sci., v. 5, no. 2, p. 275–285, illus., tables, 1968.

Samples were obtained at 13 sites in the Maringouin Formation (late Mississippian red sediments) in New Brunswick and subjected to routine thermal demagnetization. After thermal cleaning at 550°C, the results fall into two groups of comparable stability, but with different mean directions, direction dispersions, and intensities. Results from Group I show that folding was early Pennsylvanian so that magnetization was acquired before that time. Group II results may be explained by supposing that magnetization was acquired by one or more processes operating over a considerable period as the rock lithified. If the field reversed during this time, the resultant magnetization will be the vector sum of an early magnetization acquired at or soon after deposition and a later one, roughly antiparallel, acquired during diagenesis.—*from* Authors' abstract

02041 **Royse, Chester Franklin, Jr.** A stratigraphic and sedimentologic analysis of the Tongue River and Sentinel Butte Formations (Paleocene), western North Dakota [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4627B, 1968.

02082 **Rucker, James B.** Carbonate mineralogy of sediments of Exuma Sound, Bahamas: Jour. Sed. Petrology, v. 38, no. 1, p. 68–72, illus., 1968.

The carbonate mineralogy of sediments in ten cores from Exuma Sound is interpreted to reflect Pleistocene sea-level changes. An assemblage of abundant low-magnesium calcite and relatively little aragonite in the lower parts is interpreted to represent mineralogically stable, recycled sediment derived from exposed portions of the Bahama Banks exposed during the latest Pleistocene sea-level lowering. An increased aragonite content in the upper parts of the cores suggests a return to unaltered aragonitic sedimentation following restoration of sea level. The mineralogic change found in the cores is abrupt and seems not to be related to textural changes.—HEC

07169 **Rucklidge, J. C.** Electron probe studies of some Canadian telluride minerals [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 305, 1967.

02103 **Rudkin, George H.** Natural gas in San Joaquin Valley, California, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 113–134, illus., tables, 1968.

The San Joaquin Valley is a small geosynclinal basin with the structural axis lying close to the western margin. Gas is found in a variety of structural and stratigraphic traps. Typical fields representing gas production from traps of different types of rocks of different ages are described. Reserves in the valley are about 4.7 trillion cu feet, 90 percent of which is associated with petroleum as a cap or in solution. Gas is produced from rocks of Cretaceous to Pleistocene in age; the wet gas is mainly from Miocene and dry gas is largely from Pliocene rocks.—*from* Author's abstract

02042 **Ruedisili, Lon Chester.** Stratigraphy and paleontology of the Mississippian bioherms in the northern part of the Sacramento Mountains, New Mexico [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4627B–4628B, 1968.

01964 **Russell, Loris S.** A dinosaur bone from Willow Creek beds in Montana: Canadian Jour. Earth Sci., v. 5, no. 2, p. 327–329, illus., 1968.

The right tibia of an ornithopod dinosaur has been found in supposed Willow Creek beds in the Two Medicine valley southeast of Browning, Montana. This is the first report of dinosaur bones from the formation on the east side of the Alberta syncline. The specimen is referred to *Thescelosaurus*? sp., but there is some suggestion of the earlier genus *Camptosaurus*.—Author's abstract

07174 **Rutherford, M. J.; Eugster, H. P.** Experimental determination of the stability of aluminous iron biotites [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 305–306, 1967.

01914 **Rye, Robert O.; O'Neil, James R.** The O^{18} content of water in primary fluid inclusions from Providencia, north-central Mexico: Econ. Geology, v. 63, no. 3, p. 232–238, table, 1968.

The oxygen from inclusions in sphalerite from three different orebodies is 1–3 per mil lighter than value expected for pristine magmatic waters (probably because of exchange between hydrothermal fluid and crystalline granodiorite) but has composition reasonably close to that previously calculated for fluids that deposited calcite and quartz. Oxygen in inclusions in quartz and calcite has exchanged with host during cooling, but less than 45 percent of theoretical exchange at surface temperature has occurred. Carbon in sphalerite has value inferred for Providencia hydrothermal fluid, believed to be juvenile. Only 50 percent of possible exchange has occurred between fluid-inclusion carbon and calcite host. Size of inclusions may influence amount of exchange.—WSW

01998 **Sabu, D. D; Kuroda, P. K.** Fission xenon in chondrites: Jour. Geophys. Research, v. 73, no. 12, p. 3957–3964, illus., tables, 1968.

The Bruderheim chondrite contains about 1×10^{-12} ccSTP Xe-136f per g. None of the ordinary chondrites studied so far seems to contain much greater amounts of fissiogenic xenon than this. From the experimental data obtained in different laboratories the following average values were secured for the Bruderheim chondrite: Xe-136f$=1.06\times10^{-12}$ ccSTP per g; Xe-129r$=41\times10^{-12}$ ccSTP per g; I$=19$ ppb; U$=11$ ppb. The above values yield the Pu–Xe and I–Xe decay intervals of 142×10^{6} and 136×10^{6} yrs., respectively, if the initial Pu-244:U-238 and I-129:I-127 ratios immediately after cessation of nucleosynthesis were 0.0235 and 0.0030, respectively.—Authors' abstract

02126 **Sacramento Petroleum Association.** Corning and South Corning gas fields, Tehama County, California, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 635–638, illus., table, 1968.

The South Corning field is separated from the Corning field by a fault; both fields are anticlines. Production of gas from the Corning field is from the Pliocene Tehama Formation and from the Tehama and underlying Upper Cretaceous Kione Formation in the South Corning field. A cross section illustrates the progressive overlap of Cretaceous beds in a northerly direction by the basal Pliocene above an unconformity, and this may account for the unusual presence of gas in the nonmarine Tehama Formation. The gas could have originated in the underlying Cretaceous and migrated upward into the very porous basal sandstone and conglomerate of the Tehama.—HRC

02124 **Safonov, Anatole.** Stratigraphy and tectonics of Sacramento Valley, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 611–635, illus., 1968.

The Upper Cretaceous–Eocene section of Sacramento Valley is very complex. The principal tectonic factor is the progressive southward tilt of the Great Valley of California, broken by the transverse Stockton fault, the southern boundary of the valley. Another factor is the progressive uplift of the west side, which gradually caused isolation of the Sacramento basin. The third major factor is differential movements within the valley, resulting in three subbasins—Rio Vista, Colusa, and Chico. The main source of sediments was to the east. Erosional channels in the valley are peculiar: there are three—Princeton, Markley, and Brentwood gorges. There is controversy over the Meganos "shale ways," and the writer contends that these are remnants of the original Rio Vista basin on both sides of a Meganos delta.—*from* Author's abstract

07310 **Sandy, John.** Gravity investigations in Alabama [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 4, p. 342, 1967.

02022 **Sangrey, Dwight Abram.** The behavior of soils subjected to repeated loading [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4568B–4569B, 1968.

01847 **Scheffel, Mildred D.** Rock and mineral collecting sites in north central Illinois: Earth Sci., v. 21, no. 4, p. 172–175, illus., 1968.

This article supplements the author's "Fossil collecting sites in the Normal, Illinois, area" published in the May–June issue. Three sites are described: the Buckheart mine near Canton where pyrite octahedrons can be found, near Jubilee State College for cone-in-cone from Pennsylvanian rocks, and Gray's quarry near Hamilton to collect geodes.—ESL

01938 **Scheidegger, A. E.** Horton's law of stream numbers: Water Resources Research, v. 4, no. 3, p. 655–658, illus., 1968.

The possibilities for obtaining a rational explanation of Horton's law of stream numbers are reviewed. The previous explanations of the stream-number law by (1) a growth model referring to generations of rivers and by (2) statistical graph-theory are compared. The graph-theoretical explanation seems superior to the other model of Horton's law, inasmuch as it produces not only the form of the law, but even, numerically, the naturally observed bifurcation ratio. It is also independent of the structural properties of the river net.—Author's abstract

Schmitt, R. A. *See* Linn, T. A., Jr. 01979

Schnoes, H. K. *See* Huag, Pat. 01957

Schweinfurth, Stanley P. *See* Roen, John B. 01803

02057 **Scott, J. S.; Brooker, E. W.** Geological and engineering aspects of Upper Cretaceous shales in Western Canada: Canada Geol. Survey Paper 66-37, 75 p., illus., tables, 1968.

In western Canada, extensive overconsolidated clay shales of Upper Cretaceous age cause stability problems for foundations and slopes. Slope failures involving the Bearpaw Formation in Manitoba, Saskatchewan, and Alberta, indicate that prime

geologic factors affecting engineering behavior of overconsolidated shales are: depositional environment, lithology and stratigraphy, stress history, structure, climate, geomorphology, and ground water. The geometry of failure surface of retrogressive slides common in these shales is best described by a number of plane surfaces rather than by a circular arc; the wedge method of stability analysis offers an approach to slope stability prediction. The important unknown, the residual strength index value, obtained from shear tests can best be assessed on the basis of field observations.—GDC

Scott, Ronald F. *See* Ko, Hon-Yim. 01836

07175 **Scott, S. D.; Barnes, H. L.** Nonstoichiometric phase changes in sphalerite and wurtzite [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 306, 1967.

07268 **Sellars, Robert T., Jr.** The Siluro-Devonian rocks of the Ouachita Mountains, *in* Symposium—Silurian-Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 231–241, illus., 1967.

The Siluro-Devonian rocks in west-central Arkansas were deposited during a period of tectonic inactivity. The early phase of geosynclinal development, considered tectonically stable, is characterized by deposition of quartzose sandstones and carbonates, followed by a series of black carbonaceous shales, with associated bedded cherts. This latter portion is the euxinic facies. The Siluro-Devonian rocks represented in this phase are the Blaylock Sandstone, the Missouri Mountain Slate, and the Arkansas Novaculite. The bedded siliceous sediments of this sequence are thought to be primary deposits, at least partly biochemical in origin, which probably were deposited in relatively shallow water. The Siluro-Devonian rocks may be thought of as comprising an integral portion of the core of the Ouachitas.—*from* Author's abstract

07150 **Semenov, E. I.; Bukin, V. I.; Balashov, Yu. A.; Sörensen, H.** Rare earths in minerals of the joaquinite group: Am. Mineralogist, v. 52, nos. 11–12, p. 1762–1769, illus., tables, 1967.

An apparently new rare-earth mineral of the joaquinite group occurs in the nepheline-syenite pegmatites of Ilímaussaq alkaline massif, South Greenland. Its optical and X-ray data are the same as those of joaquinite from California, but the analysis of the Greenland mineral leads to the formula 4[Na $Ba_2FeCe_2Ti_2Si_8O_{26}(OH)$].—*from* Authors' abstract

Sen Gupta, P. K. *See* Johns, W. D. 07232

01816 **Seyfert, Carl K.** Structure and petrology of Pelham Bay Park, Trip G *in* Guidebook to field excursions—New York State Geol. Assoc., 40th Ann. Mtg., Flushing, N. Y., 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, p. 175–195, illus., table, geol. map, 1968.

A felsic unit, consisting of gneiss and sillimanite schist, and a mafic unit, consisting of amphibolites of various types, gneisses, and border rocks are intruded by pegmatites up to 20 feet wide; all units are described petrographically. There are four sets of foliations and two sets of folds with steeply-plunging axes which parallel mineral lineations. This is the Hutchinson River Group of pre-Devonian age. Possible correlatives are the Fordham Gneiss, the Manhattan Formation, the Taconic Sequence, or the Hartland Formation of Connecticut. A road log is given for a field trip in the region along a path in Pelham Bay Park for about two miles; and the trip makes 11 stops.—HRC

Shafiqullah, M. *See* Boyle, R. W. 02055

01918 **Shankland, T. J.** Band gap of forsterite: Science, v. 161, no. 3836, p. 51–53, illus., 1968.

Optical absorption and reflectivity measurements on synthetic forsterite show that this silicate has a wide band gap of the order of 8.4 electron volts; thus it resembles other pure insulating oxides such as MgO. For natural olivines, in which divalent

cations, mainly Fe^{+2}, can replace Mg^{+2}, all the optical absorption bands between the lattice overtones in the infrared and the first excitonic transition at 8.4 electron volts are due to the presence of iron.—Author's abstract

02013 **Sharma, Bijon; Geldart, L. P.** Analysis of gravity anomalies of two-dimensional faults using Fourier transforms: Geophys. Prosp. [Netherlands], v. 16, no. 1, p. 77–93, illus., 1968.

The Fourier transform formula for a two-dimensional fault truncating a horizontal bed at an arbitrary angle of inclination is derived. The amplitude spectrum of the Fourier transform is found to give information about the depth to the top of the upper part of the faulted bed and the inclination of the fault-plane. Under suitable conditions the thickness and the displacement of the bed involved can be obtained. With actual field data, these transforms can be obtained at discrete points by a Fourier analysis of the gravity anomaly. A field example from the Logan fault area near Montreal, Quebec, Canada, is given.—Authors' abstract

Sharp, J. H. *See* Brindley, G. W. 07148

07176 **Shaw, D. M.** Covariance analysis of K–Rb fractionation trends [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 306–307, 1967.

07177 **Shaw, D. M.** The composition of the Canadian Precambrian Shield and the upper mantle, with particular reference to U, Th, and K [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 307, 1967.

01788 **Shen, Hsieh W.; Komura, Saburo.** Meandering tendencies in straight alluvial channels: Am. Soc. Civil Engineers Proc., v. 94, paper 6042, Jour. Hydraulics Div., no. HY 4, p. 997–1016, illus., tables, 1968.

Meandering bed pattern with alternate scour holes, which occurs occasionally in rivers, was reproduced consistently in a straight laboratory flume. The occurrence of this pattern was directly related to: (1) the presence of rough walls, and (2) the increase of main flow velocity with both time and distance. This study clearly pointed out the importance of investigation on unsteady and nonuniform flows for the understanding of river morphology.—Authors' abstract

01997 **Sheridan, Robert E.; Drake, Charles L.** Seaward extension of the Canadian Appalachians: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 337–373, illus., table, 1968.

Subsurface geology of the Gulf of St. Lawrence and the continental shelf off Nova Scotia and Newfoundland is interpreted from results of 37 seismic-refraction profiles which show no indication of rifting or rotation of Newfoundland away from Quebec. The seaward extension of the Taconic orogenic zone, characterized by an intermediate crustal layer which continues intact to the continental slope northeast of Newfoundland, was not found on the Labrador shelf, suggesting that the Appalachians continued straight rather than remaining marginal to North America. The Devonian (Acadian) orogenic belt was probably not continuous with a corresponding European orogen, but the Ordovician (Taconic) orogeny may have persisted across into Europe; if so, it implies the existence of a major rift at the Newfoundland slope during middle and late Paleozoic times.—MST

Shields, Clyde E. *See* Jansen, Robert B. 01937

07178 **Shilts, W.** X-ray diffraction as a stratigraphic tool in the Pleistocene of northern Vermont and southeastern Quebec [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 307–308, 1967.

07260 **Shotts, Reynold Q.** Pseudo-volcanism and lunar impact craters [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 4, p. 342, 1967.

07294 **Shotts, Reynold Q.** The Utley coal bed in the western Warrior field: Alabama Acad. Sci. Jour., v. 38, no. 3, p. 203–214, illus., 1967.

Except for a structure contour map in Semmes' (1929) "Oil and gas in Alabama," there seems to be no mention of the Utley coal bed until it was identified in both Tuscaloosa and Jefferson Counties by Culbertson (1964). Measured elevations of Utley outcrops, between Turkey and Wolf Creeks, against elevation contours on the Semmes map corresponded so closely that Shotts, by making adjustments at points near known faults and other structural features, could trace the extent of outcrop as figured for part of the Wiley quadrangle. Shotts confirms the Utley bed as the lower of a group of coal beds between the Gwin and Brookwood groups, overlying a persistently thick sandstone, the significance of which was apparently missed by McCalley (c. 1900) who mapped it as the Thompson Mill bed, with type section at the "Utley Mine".—GDC

07298 **Shotts, Reynold Q.** The Upper Cliff coal beds on northeast Sand Mountain: Alabama Acad. Sci. Jour., v. 38, no. 2, p. 143–154, illus., tables, 1967.

In the Fabius–Flat Rock area, four coal beds have been found between two conglomerates which are the same on both Lookout and Sand Mountains. The lower and thicker coal bed in Sand Mountain correlates with the Underwood bed of Lookout Mountain; the other three are Upper Cliff beds; their stratigraphic interval is equivalent to the Signal Point shale of Tennessee. The persistent and widespread Upper Cliff strata, where best developed, are shale and sandy shale, coarsening to the north, east, and southeast. The much thinner Sand Mountain units fit descriptions on Lookout Mountain. Tables give location, thickness, bed number, and elevation of Upper Cliff coal beds in outcrops and drill holes. None seem thick enough to mine in the study area.—GDC

02164 **Shreveport Geological Society.** Stratigraphy and selected gas-field studies of North Louisiana, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 1099–1175, illus., tables, 1968.

North Louisiana is underlain by 5,000–20,000 feet of Late Triassic–Jurassic to Eocene sedimentary rocks deposited along the northern edge of the Gulf Coast geosyncline. Most of the section contains commercial oil and gas. These strata are deposited upon an undetermined thickness of Paleozoic and Triassic rocks which so far are unproductive. The rocks of each of the Mesozoic periods and Cenozoic epochs are described. Much gas has been trapped in structures related to the movement of the Jurassic salt. Several gas fields have been selected as typical examples of the occurrence of this material; the general distribution, production, and reserves are reviewed.—HRC

02099 **Silcox, John.** Thornton and Walnut Grove gas fields, Sacramento and San Joaquin Counties, California, *in* Natural gases of North America—Pt. 1, Natural gases in rocks of Cenozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 85–92, illus., 1968.

A summary is given of the Cretaceous–Tertiary history of the region. Gas occurs in rocks of these ages associated with the westward-plunging Thornton anticline; it is found in stratigraphic traps as well as in those which are structurally controlled. Gas comes from sands in the Cretaceous delta of the region, locally the "Winters" sands, and from "Starkey" sands. It also occurs in sandstones in the Paleocene and Eocene beds below the Markley gorge-deposited materials of at least middle Eocene age. Another channel sand, the Meganos, is identified, and serves as a source of gas; it is lower Eocene in age and its relationship to the Markley channel is uncertain, although it is mapped as older.—HRC

02153 **Silver, Caswell.** Principles of gas occurrence, San Juan basin, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 946–960, illus., 1968.

Gas occurs throughout the structural basin but in homoclinal positions with respect to individual sandstone lenses. The structural position of the gas deposits is not indicative of accumulation under hydrodynamic conditions. The combined evidence of geologic history, structural position, and salinity indicates normal gravitational accumulation in updip porous wedges or isolated, wholly shale-contained

stratigraphic accumulation in discrete lenses under compaction. The gas accumulation predates the formation of the basin. There is no record of sediments younger than the Eocene San Jose Formation so that gas accumulation, if related to compaction, must have occurred before late Eocene time.—*from* Author's abstract

02092 **Simonett, David S.; Morain, Stanley A.** Remote sensing from spacecraft as a tool for investigating Arctic environments, Chap. 21 *in* Arctic and alpine environments—Internat. Assoc. Quaternary Research, 7th Cong., Boulder–Denver, Colo., 1965, Proc., V. 10: Bloomington, Ind., and London, Indiana Univ. Press, p. 295–306, illus., tables, 1968.

Remote-sensor imaging systems on orbiting spacecraft may be used to obtain geomorphic and biogeographic data for theoretical and practical investigations of arctic environments. Both reconnaissance and large-scale maps and statistical data can be produced or updated by these systems in previously inaccessible areas. Multispectral photography and multifrequency infrared and radar imaging systems are potentially of great value for both long- and short-term environmental studies, including those on a Holarctic scale. Research possibilities might include: extending inferences from sites studied in detail on the ground to more inaccessible regions; mapping boundaries of permafrost and relating them to vegetation patterns; differentiating and mapping forests and tundra; recording break-up and freeze-up of major drainage systems and lakes.—*from* Authors' abstract

01708 **Simons, Philip Yale.** Polymorphism of TiO_2 minerals [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3810B, 1968.

01738 **Sims, John David.** Geology and sedimentology of the Livingston Group, northern Crazy Mountains, Montana [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3755B–3756B, 1968.

07179 **Sinclair, A. J.; Libby, W. G.** Distribution of major minerals in a stock of Nelson plutonic rock, south-central British Columbia [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 308, 1967.

02182 **Sinclair, G. Winston.** Comment on discussion [by M. Kay] and reply [by C. R. Barnes] "Stratigraphy and sedimentary environments of some Wilderness (Ordovician) limestones, Ottawa Valley, Ontario," by C. R. Barnes [1967]: Canadian Jour. Earth Sci., v. 5, no. 1, p. 172–173, 1968.

The comments deal with a statement by Kay that beds in the Rockland quarry, called Lowville by Barnes and earlier workers, lie within the Watertown Limestone. The beds are compared with the Watertown as defined at Watertown, N. Y., and the Lowville as defined at Lowville, N. Y. In physical appearance the beds resemble the Lowville, not the Watertown, and contain fossils considered as highly characteristic of the Lowville.—ESL

Sirkin, Leslie A. *See* Newman, Walter S. 01815

01838 **Sirkin, Leslie A.** Geology, geomorphology, and late-glacial environments of western Long Island, New York, Trip J *in* Guidebook to field excursions—New York State Geol. Assoc., 40th Ann. Mtg., Flushing, N. Y., 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, p. 233–253, illus., tables, 1968.

The reconstruction of Late-Wisconsin and postglacial environments in western Long Island is based mainly on the relationships between glacial deposits, geomorphology, and radiocarbon-dated pollen stratigraphy. The pollen stratigraphy and chronology for this region show consistent similarities to those of the southern New England area, but with notable exceptions: (1) a longer, more complete record is found in the south, (2) deglaciation began earlier in the terminal moraine region than in the north, (3) the pollen spectra begin with park tundra rather than high Arctic tundra, and (4) the pollen zones, especially B_2, begin earlier in western Long Island and transgress time into southern New England. A road log for a trip of 44 miles making six stops is included.—*from* Author's introduction

Skalafuris, A. J. *See* Remo, J. L. 01980

Smith, B. L. *See* Vogel, T. A. 07181

01839 **Smith, B. R.; Buol, S. W.** Genesis and relative weathering intensity studies in three semiarid soils: Soil Sci. Soc. America Proc., v. 32, no. 2, p. 261–265, tables, 1968.

Soils were selected in the Sonoita Valley, Santa Cruz County, Arizona, from a fan mixture of acid igneous alluvium and limestone fragments, and from alluvial limestone deposits, and in the Avra Valley, Pima County, from a mixed acid igneous alluvial fan. Thin sections of two profiles with argillic horizons and one without revealed only a few clay skins (illuviation cutans) and some stress cutans around edges of gravel particles. Fine clay:coarse clay ratios increased in the argillic horizon. Calcium–zirconium ratios, obtained by X-ray spectrographic analysis of the silt fraction, indicate weathering has been maximum at or near surface, decreasing with depth in all three profiles. It seems that argillic horizons in soils of arid and semiarid regions develop not solely by clay formation *in situ*, but in combination with enrichment by illuviation of fine clay.—GDC

07223 **Smith, D. G. W.** The petrology and mineralogy of some lower Devonian bentonites from Gaspé, P. Q.: Canadian Mineralogist, v. 9, pt. 2, p. 141–165, illus., tables, 1967.

Six bentonites occurring in the Shiphead Member of the Forillon Series of the Gaspé Peninsula are found to be composed dominantly of mixed layer illite–montmorillonite clays with or without small amounts of discrete illite, montmorillonite, and chlorite. Attention is drawn to the diversity of habit of the zircon in the grit fractions which in general contain sanidine, albite, quartz, biotite, zircon, and apatite and thus indicate acid to intermediate compositions for the parent ash falls. SiO_2 and alkalis have been removed and MgO and CaO added during diagenesis. Trace element data are presented and it is suggested that these and the heavy mineral suites should offer the best means of correlating bentonites over the area of depositions.—Author's abstract

01963 **Smith, F. G.** Three computer programs for contouring map data: Canadian Jour. Earth Sci., v. 5, no. 2, p. 324–327, illus., 1968.

Three programs in FORTRAN IV language, to control an IBM 7094 computer and a CALCOMP plotter for contouring map data, are described briefly. In the first program there is no information on strike to bias the contouring. In the second program prior information on strike biases the contouring. In the third program any prior information on strike is recomputed and the result biases the contouring.—Author's abstract

07221 **Smith, F. G.** Machine plotting of liquidus data of binary and ternary salt systems: Canadian Mineralogist, v. 9, pt. 2, p. 180–190, illus., table, 1967.

Programmes for machine plotting of liquidus curves of binary salt systems and liquidus isotherms of simple and reciprocal ternary salt systems have been coded in FORTRAN IV for an IBM 7094 computer and a CALCOMP plotter.—Author's abstract

Smith, James H. *See* Mellor, Malcolm. 07171

01881 **Smith, P. B.; Emiliani, C.** Oxygen-isotope analysis of recent tropical Pacific benthonic Foraminifera: Science, v. 160, no. 3834, p. 1335–1336, illus., table, 1968.

Analysis by the oxygen-isotope method of samples of benthonic Foraminifera, collected at different depths on the continental shelf and slope off western Central America, yielded isotopic temperatures agreeing closely with the temperatures measured in the field. The validity of the oxygen-isotope method as a means of analysis of paleotemperatures is further supported.—Authors' abstract

01755 **Smith, Randall William.** The magnetization and stable remanence of hematite [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4179B, 1968.

07228 **Snetsinger, Kenneth G.** Nuclei of pleochroic halos in biotites of some Sierra Nevada granitic rocks: Am. Mineralogist, v. 52, nos. 11–12, p. 1901–1903, table, 1967.

Nuclei of pleochroic halos in biotites from Sierra Nevada granitic rocks consist of zircon, monazite, xenotime, and/or apatite.—BAM

07230 **Snetsinger, Kenneth G.; Keil, Klaus.** Microspectrochemical analysis of minerals with the laser microprobe: Am. Mineralogist, v. 52, nos. 11–12, p. 1842–1854, illus., 1967.

Study of reproducibility and detection limits shows that quantitative estimation of trace elements in minerals may be carried out with the laser microprobe. Spectrochemical analysis with this device involves vaporization of a small volume of sample by means of a focused laser beam, followed by excitation of the vapor with an auxiliary spark source. Spectra are recorded photographically and interpreted according to usual spectrographic procedure. Areas as small as 50 microns in diameter and a half that in depth may be examined, so recourse to separation of minerals from their matrix is not necessary.—Authors' abstract

07180 **Sood, M. K.; Edgar, A. D.** Melting relations in undersaturated alkaline rocks, [Pt.] 2 [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 308, 1967.

Sörensen, H. *See* Semenov, E. I. 07150

01869 **Sörensen, P. Brögger.** Comments on the zoned calc-silicate lenses in the Frederikshaab area, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 49–50, 1968.

In the gneisses, the lenses occur as a minor constituent; they vary in size and are zoned concentrically from amphibolitic on the outside, through a zone of diopside, epidote, and scapolite, to the central garnet zone. Lenses in the unmigmatized hornblende schist are similarly zoned and are probably of the same origin; those in the gneiss are coarser grained. The lenses are not definitely identifiable as relic pillow structures, but they do represent remnants of calcium-rich rocks in the original material and are of premetamorphic origin.—ESL

Spears, D. A. *See* Curtis, C. D. 01916

01989 **Srivastava, Satish K.** Ephedralean pollen from the Upper Cretaceous Edmonton Formation of Alberta (Canada) and their paleoecological significance: Canadian Jour. Earth Sci., v. 5, no. 2, p. 211–221, illus., 1968.

Four form-genera viz. *Equisetosporites*, *Gnetaceaepollenites*, *Steevesipollenites* and *Singhia* are distinguished from each other and seven new species belonging to three of these genera are described. A new genus *Singhia* is erected to accomodate polyplicate ephedralean pollen having branched ridges. An ephedralean affinity with the four form-genera mentioned above is discussed. The modern species of *Ephedra* are mostly distributed in arid zones but their habitat varies considerably. *Ephedra* being anemophilous, its pollen can be carried long distances by wind. The fossil occurrence of ephedralean pollen may not be of significance in interpreting local paleoecology.—Author's abstract

02178 **Stalker, A. MacS.** Identification of Saskatchewan gravels and sands: Canadian Jour. Earth Sci., v. 5, no. 1, p. 155–163, illus., table, 1968.

'Saskatchewan gravels and sands' is the name used for numerous, widely scattered deposits found on the Canadian Prairies, representing the final phase of deposition by preglacial rivers before the first ice-sheet disrupted regional drainage. In the past, they have been identified chiefly by absence of stones from the Canadian Shield and position below the drift in buried valleys. These remain the basic criteria, but sole dependence on them has resulted in misidentifications, the number of which

can be reduced by using additional checks, including intensive study of each deposit and its topographic position, and establishing an adequate source for the gravel and sand, and competent means of transportation. The valley containing the deposit must be a part of the preglacial drainage system, and must have resembled a typical preglacial valley.—*from* Author's abstract

01892 **Starke, George W.; Howard, Arthur D.** Polygenetic origin of Monterey Submarine Canyon: Geol. Soc. America Bull., v. 79, no. 7, p. 813–826, illus., table, 1968.

Monterey Submarine Canyon, one of the World's largest and deepest, heads immediately offshore in Monterey Bay on the central California coast. Starke (1956) reported the presence of a deep buried canyon inland from, and aligned with, the head of the submarine canyon. Cumulative well records, gravity surveys, and field investigations strongly suggest that the buried ancestral canyon was eroded by fluvial processes, and that the present submarine canyon originated, at least in part, by the fluming out of the ancestral canyon by dominantly submarine processes. The presence of the ancestral canyon provides additional information on the deformational history of this part of the central California coast.—*from* Authors' abstract

01944 **Stauder, William.** Mechanism of the Rat Island earthquake sequence of February 4, 1965, with relation to island arcs and sea-floor spreading: Jour. Geophys. Research, v. 73, no. 12, p. 3847–3858, illus., tables, 1968.

Mechanisms of the main shock and of 14 larger aftershocks of the Rat Island earthquake of February 4, 1965, indicate two classes of foci. The first, including the main shock and 9 aftershocks all located within the island arc proper, corresponds either to an overthrust of the island block relative to the oceanic block or to reverse faulting oblique to the trend of the arc. The second, consisting of foci under the trench, represents fractures arising from a horizontal tensional stress. The entire motion is conformable to an oceanic plate moving under the island arc. The sequence is terminated by a transform fault at the eastern end of the active zone.—Author's abstract

Staudhammer, Karl. *See* Colville, Alan A. 07225

02172 **Stauffer, Mel R.** The tracing of hinge-line ore bodies in areas of repeated folding: Canadian Jour. Earth Sci., v. 5, no. 1, p. 69–79, illus., 1968.

The location and depth to ore bodies lying along the hinge of either refolded or superposed folds can be determined by using simple geometric constructions. Methods are presented here for tracing hinge-line ore bodies for several common multiple fold situations.—Author's abstract

01718 **Stauft, D. L.** Computer applications in an oil-exploration company: Bull. Canadian Petroleum Geology, v. 16, no. 1, p. 64–86, illus., tables, 1968.

An oil company has introduced the computer to its operations explorationists by providing retrievals and search-narrowing techniques for use with its computerized banks of basic geological and engineering data, thus making them aware that 'computer techniques', without necessarily revolutionizing their approach to geology, can save considerable time in searching for and gathering data from day to day. They now use such facilities as listing of cores or tests by formation, structure and isopach listings, map-plotting and contouring, show-map construction, basic cross-sectioning, and trend analysis. Without this introductory phase of simple applications, it is doubtful that they would even yet have accepted the computer as a useful tool.—*from* Author's abstract

07257 **Stehr, Raymond A.; Bowles, R. C.** Maynard Herman Steig (1904–1965): Tulsa Geol. Soc. Digest, v. 35, p. 291–292, 1967.

Steinfink, H. *See* Susa, K. 07318

07301 **Stephenson, Henson K.; Karrh, John B.** Compacted soil strength estimated from grain size distribution and soil binder analysis [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 3, p. 262, 1967.

01700 **Steven, Thomas A.** Critical review of the San Juan peneplain, southwestern Colorado: U.S. Geol. Survey Prof. Paper 594–I, p. I1–I19, geol. map, 1968.

A review of many local areas interpreted to be remnants of the San Juan peneplain indicates that most are somewhat modified original constructional surfaces, stripped surfaces on resistant layers, or exhumed surfaces of diverse origin. Bedrock structures show little or no similarity to many of the structures postulated on the basis of the peneplain concept. The detailed geologic history of the central San Juan Mountains indicates no peneplain cycle of erosion between the end of major volcanism and the present. Rather, the original surface of volcanic accumulation was only slightly modified from the end of major volcanic activity in late Oligocene and early Miocene time until regional epeirogenic uplift of the Southern Rocky Mountains in the late Cenozoic caused widespread erosion and canyon cutting.—TAS

01739 **Stone, George Thomas.** Petrology of Upper Cenozoic basalts of the western Snake River Plain, Idaho [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3756B, 1968.

01825 **Straka, Joseph J., 2d.** Conodont zonation of the Kinderhookian Series, Washington County, Iowa: Iowa Univ. Studies Nat. History, v. 21, no. 2, 71 p., illus., 1968.

Conodonts (8 form-genera, 25 species, none new) are described from a Kinderhook section, which is correlated with sections in north-central Iowa, Burlington, and western Illinois. The Devonian–Mississippian boundary in this section, not accurate because of the sparse conodont fauna, is placed at the base of the English River Formation, here considered a basal siltstone facies of the McCraney Formation; conodonts of the underlying Maple Mill suggest Famennian (Late Devonian) age. Conodonts diagnostic of the *Siphonodella quadruplicata–S. crenulata* Zone occur in the upper McCraney and lower Prospect Hill. The upper Prospect Hill and Wassonville have a fauna of the *S. isosticha–S. cooperi* Zone. Burlington Limestone conodonts are characteristic of the *Bactrognathus–Taphrognathus* Zone (Osagean) of the midcontinent.—VMJ

01949 **Strangway, David W.; Larson, E. E.; Goldstein, M.** A possible cause of high magnetic stability in volcanic rocks: Jour. Geophys. Research, v. 73, no. 12, p. 3787–3795, illus., table, 1968.

A model based on ellipsoidal particles is presented to account for many of the magnetic characteristics of basic volcanic rocks. Elongated grains are common in those basic rocks in which high-temperature oxidation has produced ilmenite lamellas in the titanomagnetite crystals. This shows that many of these grains are small enough and elongated enough to behave as single domains. The model explains (1) why only volcanic rocks that have extremely small grains from initial crystallization or that show extensive lamella development in large grains are magnetically stable, (2) the observation that warming a specimen from −143°C in zero field does not destroy the stable TRM, and (3) the extremely stable fraction of TRM found in volcanic rocks, even when they are demagnetized in fields of 1000 oe or more.—Authors' abstract

02000 **Straw, Allan.** Late Pleistocene glacial erosion along the Niagara Escarpment of southern Ontario: Geol. Soc. America Bull., v. 79, no. 7, p. 889–910, illus., 1968.

A large number of re-entrants in the Niagara Escarpment, severely indenting the outcrop of the Lockport–Amabel dolomite are believed to have been induced largely by glacial agencies. This belief is based on a consideration of moraine and drumlin trends and meltwater drainage lines. Three main phases of ice advance and recession within the Late Wisconsin and a general advance within the Early Wisconsin are envisaged, during which ice repeatedly flowed along and probably greatly enlarged

many of the re-entrant valleys. Large-scale glacial erosion is demonstrated along the Niagara scarp where it fronts onto Georgian Bay. Less intense erosion is considered to have affected the remainder of the scarp, though the Dundas valley is also regarded as a major glacial trough. These conclusions weigh heavily against contentions that recognizable "preglacial" features persist along or in front of the Niagara Escarpment.—*from* Author's abstract

Sudo, Ken. *See* Takeuchi, Hitoshi. 01942

02137 **Suey, Harry.** Provost gas field, Alberta, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 721–725, illus., 1968.

The Provost gas field of east-central Alberta produces from sandstone in the Viking Formation of Early Cretaceous age. It was discovered in 1946 by Imperial Oil Ltd. Subsequent drilling determined the field outline and development drilling has continued to the present. The field is of the stratigraphic-trap type; the sandstone ranges from zero to 25 ft in thickness. Local structure appears to have little bearing on the sandstone development. There are 106 wells capable of production within a proved area of 416,640 acres. Gas reserves are estimated to be 854 billion cu ft.—Author's abstract

Suffel, G. G. *See* Mookherjee, Asoke. 01986

Suffell, G. G. *See* Mookherjee, A. 07164

02043 **Sundeen, Stanley Paul.** The petrology of a magnetite rich portion of the Negaunee Iron-Formation in the southeast part of the Marquette Range, Michigan [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4628B–4629B, 1968.

07318 **Susa, K.; Steinfink, H.; Bradley, W. F.** The crystal structure of a pyridine-vermiculite complex: Clay Minerals, v. 7, no. 2, p. 145–153, illus., tables, 1967.

A pyridine-vermiculite complex has been investigated by three dimensional X-ray diffraction techniques. The preparation of the complex was carried out at a pH~ 4 using a solution of pyridinium hydrochloride. Exsolved magnesium from the octahedral positions satisfied approximately one-half of the cation exchange capacity. The rest of the exchange capacity is satisfied by hydrogen ions and pyridinium ions which are statistically distributed over crystallographic sites so that less than three electrons per A^3 are present at any given point. Three dimensional difference electron density maps did not locate the carbon atoms except to indicate that the organic molecule occupies positions in the true and in the two pseudo mirror planes in the unit cell. Water molecules were present in the interlayer in octahedral arrangement around the cation as in the natural mineral.—Authors' abstract

Sutheimer, A. F. *See* Arteaga, F. E. 01879

01996 **Sutton, D. J.** Rayleigh wave group velocities in central California: Seismol. Soc. America Bull., v. 58, no. 3, p. 881–890, illus., tables, 1968.

Experimentally determined Rayleigh-wave dispersion curves of group velocity are given for five paths from NTS to stations in the network operated by the Seismographic Station at U. C. Berkeley. Periods observed range from 4 to 14 seconds. Although, as expected, two different paths from NTS to the western edge of the Sierra Nevada resulted in similar curves, efforts to find empirical curves appropriate to the Great Valley and the Coast Ranges on the assumption of provinces with parallel boundaries were not successful. Estimates of group velocity across the Great Valley along the path NTS to BRK indicate velocities, in the period range 5–9 seconds, considerably lower than would be expected from crustal models so far suggested.—Author's abstract

01861 **Sutton, J.; Watterson, J.** The flat-lying metamorphic complex and related igneous rocks of the Kap Farvel area, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 58–60, 1968.

High-grade crystalline rocks derived from a supracrustal succession of clastics underlie the Kap Farvel area. The complex contains recumbent isoclinal folds, and defines a gentle dome. A granodiorite sheet, regionally concordant, but locally discordant, divides the supracrustal rocks into an upper and lower series. Regional metamorphic boundaries are gently inclined, the center of the dome being characterized by granulite facies, and the higher parts of the succession by amphibolite facies; these variations are paralleled by variation in the character of the late-plutonic igneous rocks of the rapakivi suite. Collapse structures developed by flow deformation rather than fracturing are most marked adjacent to members of the igneous suite within highest grade metamorphic rocks.—ESL

01987 **Swift, D. J. P.; McMullen, R. M.** Preliminary studies of intertidal sand bodies in the Minas Basin, Bay of Fundy, Nova Scotia: Canadian Jour. Earth Sci., v. 5, no. 2, p. 175–183, illus., 1968.

Sand winnowed from bay-floor deposits and eroded from sea cliffs has been swept into a series of intertidal sand-body complexes. Continuous seismic profiles show that these are plano-convex or tabular sand masses up to 30 m thick and 30 km long. Two types of complex are present: the Windsor Bay tidal delta type, and the Cobequid Bay braided type. Tidal current velocity data indicate two regimes: a high-water sheet-flood phase and a low-water channel phase. The flood asymmetry of the bars and larger sand waves is a consequence of the skewed nature of the tidal cycle. Sand transport in the Minas Basin seems to be eastward, along both shores.—*from* Authors' abstract

Sykes, Lynn R. *See* Tobin, Don G. 01943

Taber, R. D. *See* Hoffman, R. S. 02080

Tailleur, Irvin L. *See* Patton, William W., Jr. 01809

01942 **Takeuchi, Hitoshi; Sudo, Ken.** Partial derivatives of free oscillation period with respect to physical parameter changes within the Earth: Jour. Geophys. Research, v. 73, no. 12, p. 3801–3806, illus., tables, 1968.

By using energy equations, which are equivalent to fundamental equations and boundary conditions in free oscillation problems, we can get analytical expressions for partial derivatives of the free oscillation period with respect to changes of physical parameters within the Earth. The self-gravitation of the Earth is taken into account. The partial derivative method can reproduce the results for the M3 model by Landisman and others and the R1 model by Dorman and others satisfactorily.—Authors' abstract

01832 **Tappan, Helen.** Primary production, isotopes, extinctions and the atmosphere: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 4, no. 3, p. 187–210, illus., tables, 1968.

Phytoplankton photosynthesis has controlled atmospheric carbon dioxide-oxygen balance since early Precambrian when algal abundance became sufficient to convert the reducing atmosphere to an oxygenic one. Later phytoplankton maxima indicated in the geologic record coincide with and are here suggested to have caused extensive biogenic calcareous deposition, and evolutionary diversification of the contemporaneous biota. In contrast, onset of decreased productivity in the geologic past triggered a general biotic turnover on both land and sea. Times of phytoplankton extinctions coincide with similar periods affecting animal taxa rather than terrestrial plants. Phytoplankton abundance may have been controlled by contemporaneous continental physiography, through its effect on climate, atmospheric circulation, and oceanic upwelling.—*from* Author's abstract

02091 **Tedrow, J. C. F.; Brown, J.** Soils of Arctic Alaska, Chap. 20 *in* Arctic and alpine environments—Internat. Assoc. Quaternary Research, 7th Cong., Boulder-Denver, Colo., 1965, Proc., V. 10: Bloomington, Ind., and London, Indiana Univ. Press, p. 283–294, illus., 1968.

The Arctic slope of Alaska includes three physiographic provinces: the northern Brooks Range, Foothills, and Coastal Plain; their varied landforms, substrates, and biotic and climatic gradients combine to produce many soil varieties. Ten soil zones, controlled largely by physiography and geology, are presently mapped on a scale of 1:5,000,000, with more detailed mapping at Point Barrow, Umiat, Howard Pass, Okpilak River and other areas. The main soils are Arctic Brown, occupying well-drained areas of the Brooks Range and Foothills, and Tundra and Bog soils over much of the Coastal Plain. Patterned ground is present in many forms; ice-wedge polygons predominate on the Coastal Plain and sorted circles, nets, and polygons on bouldery valley and upland terrain of the mountains and foothills.—VMJ

02130 **Teitsworth, Robert A.** Lathrop gas field, San Joaquin County, California, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 653–663, illus., table, 1968.

Lathrop field is in the area known as the Manteca Arch. Continental Pliocene–Miocene strata unconformably overlie a thick Upper Cretaceous section. The Stockton fault nearly intersects the field's northern limit. Gas is trapped primarily in the Upper Cretaceous E-zone sandstone in anticlinal folding. Nine distinct E-zone reservoirs are known, separated by thin bounding shale beds.—*from* Author's abstract

02016 **Teng, Ta-Liang; Richards, Paul G.** Diffracted SH and SV: Nature, v. 218, no. 5147, p. 1154–1155, illus., 1968.

The great amplitude contrast of diffracted SV and SH waves observed at distances from 99° to 128° has been explained in terms of the faulting orientation (Cleary, Porra, and Read, 1967). An alternative explanation is offered here. Ultrasonic model experiments have shown that at finite frequency the shadow boundary (defined as the point where diffracted amplitudes drop to half their original value) shifts away from the geometric shadow boundary into the illuminated region, the amount of shift being larger for SV than for P. This suggests an early disappearance of SV in contrast to P at teleseismic distances. Parallel analyses have substantiated these findings and have further shown that in contrast, at a finite frequency, the shadow boundary for SH shifts into the shadow zone.—DBV

01971 **Terasmae, J.; Lasalle, P.** Notes on late-glacial palynology and geochronology at St. Hilaire, Quebec: Canadian Jour. Earth Sci., v. 5, no. 2, p. 249–257, illus., tables, 1968.

A palynological study supported by radiocarbon dates of late-glacial sediments at St. Hilaire, Quebec, indicates that the southern part of the St. Lawrence Lowland was deglaciated prior to 12,500 yr B.P. The late-glacial episode comprises several climatic fluctuations: a probable early cool interval (northern boreal) more than 12,500 yr B.P.; a relatively colder interval (tundra) about 12,500 yr B.P. followed by another cool interval from about 12,000 yr B.P. to about 10,000 yr ago. Another relatively cold episode may have occurred about 11,000 yr ago. The new studies extend the previously available palynological record in the St. Lawrence Lowland back in time by about 2,000 yr and include the Champlain Sea episode.—Authors' abstract

02076 **Texas University Bur. Econ. Geology.** Geologic atlas of Texas, Beaumont sheet—Harold Norman Fisk Memorial Edition: Austin, Tex., Univ. Texas Bur. Econ. Geology, scale 1:250,000, 1968.

02077 **Texas University Bur. Econ. Geology.** Geologic atlas of Texas, Houston sheet—Paul Weaver Memorial Edition: Austin, Tex., Univ. Texas Bur. Econ. Geology, scale 1:250,000, 1968.

02078 **Texas University Bur. Econ. Geology.** Geologic atlas of Texas, Plainview sheet—William Fletcher Cummins Memorial Edition: Austin, Tex., Univ. Texas Bur. Econ. Geology, scale 1:250,000, 1968.

07296 **Texas University Bur. Econ. Geology.** Geologic atlas of Texas, Van Horn–El Paso sheet—E. Russell Lloyd Memorial Edition: Austin, Tex., Univ. Texas Bur. Econ. Geology, scale 1:250,000, separate text, 1967.

07297 **Texas University Bur. Econ. Geology.** Geologic atlas of Texas, Palestine sheet—Sidney Powers Memorial Edition: Austin, Tex., Univ. Texas Bur. Econ. Geology, scale 1:250,000, 1967.

02044 **Thayer, Paul Arthur.** Geology of the Dan River and Davie County Triassic basins, North Carolina [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4629B, 1968.

07287 **Thomas, Harold E.; Peterson, Dean F., Jr.** Groundwater supply and development, Chap 7 *in* Irrigation of agricultural lands (R. M. Hagan, H. R. Haise, and T. W. Edminster, editors): Madison, Wis., Am. Soc. Agronomy (Agronomy, no. 11), p. 70–91, 1967.

Ground water is the most abundant fresh-water resource in the world. Subjects covered in the chapter include: exploration, primarily occurrence; well development, including exploration to depth; well hydraulics, including aquifer characteristics, degree of confinement, leaky aquifers and multiaquifer wells, and lateral boundaries; and reservoir management.—ESL

07309 **Thomas, William A.** Mississippian formations and zones in Alabama [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 4, p. 343, 1967.

02083 **Thrailkill, John.** Dolomite cave deposits from Carlsbad Caverns: Jour. Sed. Petrology, v. 38, no. 1, p. 141–145, illus., 1968.

A number of cave deposits from Carlsbad Caverns, New Mexico, have been found to contain secondary dolomite; that in one deposit, consists of a mixture of protodolomite and high-magnesium calcite. The dolomite apparently is pseudomorphic after and derived from aragonite at temperatures less than 20°C and in contact with water with a high $a_{Mg}{}^{++}/a_{Ca}{}^{++}$ ratio.—*from* Author's abstract

Thurber, David L. *See* Newman, Walter S. 01815

Time-Life Books Editors. *See* Beiser, Arthur. 01873

01943 **Tobin, Don G.; Sykes, Lynn R.** Seismicity and tectonics of the northeast Pacific Ocean: Jour. Geophys. Research, v. 73, no. 12, p. 3821–3845, illus., tables, 1968.

The hypocenters of 260 earthquakes, in the period 1954–1964 in the northeast Pacific and adjacent continental areas, were relocated to study the relation of seismicity to large-scale tectonic features between the Mendocino fracture zone and central Alaska. Nearly all the earthquakes on the Blanco fracture zone were concentrated between the Gorda and Juan de Fuca ridges. Evidence from the distribution and mechanism of earthquakes suggests that the San Andreas fault bends abruptly near Cape Mendocino and follows the seismically active part of the Mendocino fracture zone. The distribution of epicenters suggests that the main zone of present-day seismic activity in southeastern Alaska follows the Fairweather fault, passes out to sea near 58°30′ N., remains offshore, and continues as far south as the northern end of Juan de Fuca ridge.—*from* Authors' abstract

Tobisch, Othmar T. *See* Nelson, Arthur E. 01807

02060 **Toman, K.; Frueh, A. J., Jr.** Diffraction of X-rays by the faulted cylindrical lattice of chrysotile—[Pt.] 1, Numerical computation of diffraction profiles: Acta Cryst., v. A24, pt. 3, p. 364–373, illus., 1968.

The current theory of the diffraction of X-rays by a cylindrical lattice is supplemented, and the influence of some misfit boundaries discussed. The numerical computation of diffraction profiles of some reflections was carried out, and the influence of the curvature, wall thickness, incompleteness and the presence of several types of misfit boundaries determined.—Authors' abstract

02061 **Toman, K.; Frueh, A. J., Jr.** Diffraction of X-rays by the faulted cylindrical lattice of chrysotile—[Pt.] 2, The form, position and width of some diffraction profiles: Acta Cryst., v. A24, pt. 3, p. 374–379, illus., tables, 1968.

The measurements of the form, position and half-height width of some important reflections were carried out on 15 chrysotile fibers from different localities [mostly Quebec]. The samples do not differ significantly in length of reciprocal lattice parameters a*, b*, mean diameter of cylindrical lattice and wall thickness. We found for these characteristics the following average values: $a^* = 0.06855$ A, $b^* = 0.10860$ A, the mean diameter 234 A, and the wall thickness 155 A. The samples differ significantly in the different degree of axial disorder present in the cylindrical lattice.—Authors' abstract

07279 **Toomey, Donald F.** (editor). Symposium—Silurian-Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 21–276, illus., tables, 1967.

This symposium contains fourteen separately cited papers, each dealing with a different aspect of the subject. Geographically, the area ranges from the Appalachians to New Mexico and from Kansas to Texas.—HRC

02159 **Townsend, John V.** Trawick gas field, Nacogdoches County, Texas, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 1013–1019, illus., 1968.

Gas of Trawick field comes from the Pettet Member of the Glen Rose Formation. The field is on a low-relief anticline in the East Texas geosynclinal basin off the southwest flank of the Sabine uplift. Structural growth increases progressively with depth so that there is 140 feet of closure in the Pettet Member. The trap is partly stratigraphic. Gas-condensate comes also from the Rodessa Member of the Glen Rose, and lenticular zones in the Pettet-Travis Peak transition zone contain gas-condensate.—*from* Author's abstract

01802 **Trace, Robert D.; Kehn, Thomas M.** Geologic map of the Olney quadrangle, Caldwell and Hopkins Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-742, scale 1:24,000, section, text, 1968.

Fluorite and minor amounts of associated sphalerite, galena, and barite have been mined from the Tyrie and other mines along the Tabb fault system near the western edge of the Olney quadrangle; mines have been inactive for about 20 years. Three inactive limestone quarries in the southeastern sections were worked in units of the Menard and Kinkaid Limestones to produce road metal.—MCM

Trautz, O. R. *See* Klein, E. 07196

Trautz, O. R. *See* LeGeros, R. Z. 07197

01688 **Tremblay, L. P.** Geology of the Beaverlodge mining area, Saskatchewan: Canada Geol. Survey Mem. 367 (advance edition), 452 p., illus., tables, 1968.

All rocks are Precambrian in age, the Tazin Group being the oldest and covering about 70 percent of the area. Rocks of the Group have been regionally metamorphosed into the amphibolite facies—quartzites, amphibolites, garnet-bearing rocks; large areas were granitized into red granite and gneisses. The Martin Formation overlies these unconformably, and consists of basal conglomerate, very thick arkose and siltstone, a few conglomerate interbeds, and basalt flows and gabbro sills. All rocks have been folded, the older more than once. Large areas of the Tazin are brecciated and mylonitized, and probably represent major thrust faults. The main faults of the area are later and part of an intense deformation. Uranium is the only metal found in economic quantity and occurs in areas of granitized rocks associated with major faults.—ESL

02049 **Trembly, Lynn Dale.** Seismic source characteristics from explosion generated P waves [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4631B–4632B, 1968.

Trexler, J. Peter. *See* Wood, Gordon H., Jr. 01783

01785 **Trexler, J. Peter; Wood, Gordon H., Jr.** Geologic map of the Valley View quadrangle, Schuylkill and Northumberland Counties, Pennsylvania: U.S. Geol. Survey Geol. Quad. Map GQ-699, scale 1:24,000, sections, 1968.

01786 **Trexler, J. Peter; Wood, Gordon H., Jr.** Geologic map of the Klingerstown quadrangle, Northumberland, Schuylkill, and Dauphin Counties, Pennsylvania: U.S. Geol. Survey Geol. Quad. Map GQ-700, scale 1:24,000, sections, 1968.

01899 **Tuck, Ralph.** Origin of the bedrock values of placer deposits [discussion of paper by E. S. Cheney and T. C. Patton, 1967]: Econ. Geology, v. 63, no. 2, p. 191-193, 1968.

As a land surface is lowered by dissection, the gold always tends to remain on or near bedrock while the lighter particles are sluiced away. Gold sufficiently coarse to form commercial placers (particles exceed 1 milligram) may not travel horizontally much farther than it drops vertically with respect to its original site in bedrock. Greatest concentration occurs in narrow valleys during active degradation. Lesser concentrations and dissemination may form at higher levels in gravels when the stream becomes more aggradational later in the erosional cycle. Similar considerations apply to marine placers. (For original paper, *see* ibid., v. 62, p. 852-853, 1967.)—WSW

01966 **Tuke, M. F.** Autochthonous and allochthonous rocks in the Pistolet Bay area in northernmost Newfoundland: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 501-513, illus., tables, 1968.

Rocks outcropping in northern Newfoundland belong to two sequences which are partly contemporaneous and very different in lithology. One consists of Lower Cambrian sandstones and Lower and Middle Ordovician carbonates and shales, the other of graywackes, volcanics, and ultrabasic intrusions, which are, in part, early Ordovician. The second sequence is interpreted as allochthonous because it is underlain by major low-angle faults and because of its strong facies contrast with the first sequence. The allochthonous rocks occur in three separate klippen, which probably originated in an area 60 km to the southeast and is on strike with similar rocks in north-central Newfoundland. Field evidence indicates that movement on the faults underlying them was to the northwest. The klippen probably moved by gravity sliding in late Middle Ordovician time.—MST

07256 **Tulsa Geological Society.** George S. Buchanan (1902-1967): Tulsa Geol. Soc. Digest, v. 35, p. 290, portrait, 1967.

07258 **Tulsa Geological Society.** Allen G. Oliphant (1899-1967): Tulsa Geol. Soc. Digest, v. 35, p. 292-293, 1967.

Tupper, W. M. *See* Boyle, R. W. 02055

Turekian, K. K. *See* Kharkar, D. P. 01956

Uchida, Kinsuke. *See* Morinage, Shigeru. 01833

07186 **Uhlmann, Donald R.; Jackson, Kenneth A.** Frost heave in soils—The influence of particles on solidification, *in* Physics of snow and ice—Internat. Conf. on Low Temperature Science, Sapporo, Japan, 1966, Proc., V. 1, Pt. 2: Sapporo, Japan, Hokkaido University, p. 1361-1373, illus., table, 1967.

Decisive conditions for ice lens formation in soils may be understood by considering the channel propagation and particle trapping aspects of the problem. Expressions are derived here for the frost heave rate as a function of various parameters used to characterize the soils. Two limiting cases are identified: one corresponding to particle entrapment appropriate for coarse sand soils, and one to channel propagation appropriate to fine silty soils. A more definitive test of the theory is provided by experiments on a soil separated into fractions of different particle size, or on an artificial soil composed of readily characterized particles. In either

case, a detailed knowledge of particle peripheries is required.—*from* Authors' conclusions

02070 **U.S. Geological Survey.** Aeromagnetic map of the Chester quadrangle and parts of the Beckett and Blandford quadrangles, Berkshire, Hampden, and Hampshire Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-625, scale 1:24,000, 1968.

02071 **U.S. Geological Survey.** Aeromagnetic map of the Goshen quadrangle and part of the Ashfield quadrangle, Franklin and Hampshire Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-626, scale 1:24,000, 1968.

02072 **U.S. Geological Survey.** Aeromagnetic map of the Worthington quadrangle and parts of the Plainfield and Peru quadrangles, Berkshire and Hampshire Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-627, scale 1:24,000, 1968.

02073 **U.S. Geological Survey.** Aeromagnetic map of the Westhampton quadrangle and part of the Woronoco quadrangle, Hampshire County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-628, scale 1:24,000, 1968.

07286 **U.S. Interagency Comm. Oceanography.** University curricula in the marine sciences—Academic year 1967-68: U.S. Interagency Comm. Oceanography ICO Pamph. 30, 157 p., 1967.

Preliminary sections in the catalog prepared for the National Council on Marine Resources and Engineering Development give typical requirements for undergraduate preparation, financial assistance programs, a list of university curricula by geographic location, and an alphabetical list of universities. The three chapters in the main body cover curricula in marine sciences, ocean engineering, and marine technology. An alphabetical faculty list and a list of degrees granted by universities complete the catalog.—ESL

Vacquier, Victor. *See* Corry, Charles. 01814

01813 **vanAndel, Tjeerd H.** The structure and development of rifted midoceanic rises: Jour. Marine Research, v. 26, no. 2, p. 144-161, illus., 1968.

Midoceanic rises can be divided into two categories—rifted and nonrifted. Rifted rises are characterized by a median valley, high relief, a thick second layer, and presence of metamorphic and deep intrusive rocks; they are believed to have slow spreading rates. A three-phase history is suggested: accumulation of plateau basalts, compensated by rising of a metamorphic front at depth, and with normal faulting at the flanks; followed by a long period of tectonic quiescence and sedimentation; then the crest was lifted again forming the central graben, and the crest and flanks deformed by gravity-sliding and normal faults. This development yields a symmetric pattern of magnetic anomalies and is consistent with geologic data; it does not permit recent sea-floor spreading outside the central rift. A need is suggested for continuing examination of the reality of magnetic models, and rigorous proof of the validity of magnetic correlations.—*from* Author's abstract

01968 **vanEverdingen, R. O.** Studies of formation waters in Western Canada—Geochemistry and hydrodynamics: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 523-543, illus., 1968.

The existence of major flow systems in the Western Sedimentary Basin of Canada is reflected in the chemical composition and degree of concentration of the formation waters involved. Subsurface salt solution and collapse, and accumulation and destruction of hydrocarbon 'deposits' are directly related to such flow systems. Many occurrences of 'anomalies' in pressure, chemical composition, and concentration may be explained on the basis of membrane behavior of shales. The presence of organic matter may have an important influence on composition of formation waters. More sophisticated sampling techniques combined with more detailed analysis of formation waters are needed to develop the full potential benefit of formation water studies for the petroleum industry.—Author's abstract

01828 **VanLoon, J. C.; Parissis, C.** Rapid scheme of silicate analysis based on the lithium metaborate fusion followed by atomic absorption spectrometry—[Pt.] 1, Determination of silica: Anal. Letters, v. 1, no. 8, p. 519–524, table, 1968.

A method for the rapid determination of silica in silicates is given based on the superior lithium metaborate fusion with a view to the development of a total atomic absorption scheme of silicate analysis using this fusion. Interferences usually associated with solutions of this nature are studied. Results are given for several standard silicate samples.—Authors' abstract

07303 **Varnedoe, William W., Jr.** Some unresolved problems in speleogenesis [abs.]: Alabama Acad. Sci. Jour., v. 38, no. 3, p. 231, 1967.

Vaughan, Richard H. *See* Ditzler, Clark C. 02102

02129 **Vaughan, Richard H.** Arbuckle gas field, Colusa County, California, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 646–652, illus., 1968.

The Arbuckle field is an excellent example of a combination structural–stratigraphic trap with gas accumulation contained in a series of lenticular Upper Cretaceous sandstone bodies that cross a gently folded and rather complexly faulted terrace. The field is on a local nosing terrace superposed on an east-dipping regional homocline. The Arbuckle terrace has a maximum width of two miles. The gas occurs in sand bodies in the Forbes Shale of Cretaceous age. The sandstones are offshore or basinal of current derivation, and are largely nonadditive. Detailed studies show that the Arbuckle flexure was in existence at the time of deposition of the gas sands and may have had some influence on deposition.—HRC

Vian, Richard W. *See* Heinrich, E. William, 07222

07181 **Vogel, T. A.; Smith, B. L.** Coexisting feldspars from some charnockite-like rocks in New Jersey, U.S.A. [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 309, 1967.

Vohryzka, Kurt. *See* Lehnert-Thiel, Klaus, 01824

01740 **Vokes, Emily Hoskins.** Cenozoic Muricinae of the western Atlantic region [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 9, p. 3756B–3757B, 1968.

01910 **Wadsworth, William B.** The Cornelia pluton, Ajo, Arizona: Econ. Geology, v. 63, no. 2, p. 101–115, illus., tables, 1968.

Extreme tilting and faulting of the Cornelia pluton has exposed rocks that once lay far below the mineralized apex, as has been pointed out by Gilluly (1946). Petrographic study of specimens from 65 localities in the deeper zone, spaced 0.25 mi apart in a grid, has identified a sequence of temporally discrete intrusive episodes. Lithologic varieties are, from oldest to youngest, quartz diorite, granodiorite, equigranular quartz monzonite, porphyritic quartz monzonite, and porphyritic microquartz monzonite. The shape of the last-named centrally situated body is similar to that of the New Cornelia ore body, and the unit is lithologically correlative with those that predominate in the mine area, suggesting that it represents the conduit.—WSW

01853 **Waldron, L. J.; Constantin, G. K.** Bulk volume and hydraulic conductivity changes during sodium saturation tests: Soil Sci. Soc. America Proc., v. 32, no. 2, p. 175–179, illus., 1968.

Fragmented samples of one organic and five mineral soils of California were permeated with salt solutions while confined under constant stress. Continuous and precise measurement of bulk volume changes showed that while hydraulic conductivity decreased upon changing to more dilute solution, the bulk volume increased with some soils and decreased with others. Aggregate failure was an important mechanism of the hydraulic conductivity decline, but following the first bulk volume decrease, subsequent changes in bulk volume and hydraulic conductivity were inversely related, indicating that *in situ* swelling and shrinking

became dominant mechanisms. It is emphasized that pore-size distribution rather than pore volume governs hydraulic conductivity, depending on variation of stress from point to point within the soil.—GDC

02152 **Walton, Paul T.** Wasatch Plateau gas fields, Utah, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 928–945, illus., tables, 1968.

Gas in the Wasatch Plateau occurs in the Clear Creek, Flat Canyon, Joes Valley, and Ferron fields. All production is from closed structural features and the principal zone is the Cretaceous Ferron Sandstone Member of the Mancos Shale. Clear Creek, the most important field, is located on a regional uplift that has been transected by major faults which have formed a graben. The Ferron Sandstone appears to have had two sources, one to the southwest and the other the northwest. The northwestern-derived sand is the better reservoir. Future discoveries appear to depend upon testing of undrilled structural closures, stratigraphic analyses of the Ferron, Dakota, Star Point, and Emery Sandstones for flank traps, and deep drilling to the known Paleozoic porous rocks, principally Mississippian limestones.—*from* Author's abstract

02045 **Waltz, James Patterson, 2d.** An analysis of selected landslides in Alameda and Contra Costa Counties, California [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4629B–4630B, 1968.

02019 **Wang, Chi-Yuen.** Ultrasonic study of phase transition in calcite to 20 kilobars and 180°C: Jour. Geophys. Research, v. 73, no. 12, p. 3937–3944, illus., 1968.

The velocity of compressional waves of ultrasonic frequencies in Danby marble was measured under external hydrostatic pressure up to 20 kb and at elevated temperature to 180°C. The velocity-versus-pressure curves at elevated temperature show similar characteristics to the curves at room temperature. The velocity rises with pressure to a maximum and falls within a short range of pressure to a minimum and rises again with pressure. Pairs of temperature and pressure values associated with the sudden change of velocity define the phase boundary of the structural transition; the slope of this phase boundary is determined as −76.7°C per kb. Comparing this slope with Bridgman's phase diagram for calcite I–II–III, and the phase diagram of calcite-aragonite, it can be shown that the structural transition associated with the sudden change of velocity is calcite I to calcite II.—*from* Author's abstract

01973 **Wanless, R. K.; Loveridge, W. D.; Mursky, G.** A geochronological study of the White Creek batholith, southeastern British Columbia: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 375–386, illus., tables, 1968.

Rb-Sr and K-Ar age measurements for whole-rock and mineral samples of the various rock units of the White Creek batholith and adjacent Precambrian country rocks are reported. Four geological events have been identified: (1) emplacement and(or) consolidation of marginal zones of the batholith at, or subsequent to, 126 m.y.; (2) final consolidation of the leucocratic quartz monzonite core rocks at 111±5 m.y.; (3) a period of thermal activity affecting all batholithic rocks at 85 m.y.; and (4) a second thermal event affecting all batholithic rocks and resulting in partial, localized redistribution of radiogenic argon and strontium at 65 m.y.—*from* Authors' abstract

01796 **Waters, A. C.** Reconnaissance geologic map of the Post quadrangle, Crook County, Oregon: U.S. Geol. Survey Misc. Geol. Inv. Map I-542, scale 1:62,500, 1968.

Waters, Aaron C. *See* Gilluly, James. 01772

Watkins, N. D. *See* Dymond, J. R. 01941

01791 **Watt, A. K.** Pleistocene geology and ground water resources, Township of Etobicoke, York County: Ontario Dept. Mines Geol. Rept. 59, 50 p., illus., tables, geol. map, 1968.

The Dundas Formation forms the bedrock of the township and deposits from at least two glaciations form the overburden. The Illinoian is represented by a blue-gray till with numerous stones. Three till sheets of Wisconsin age are found; results of their mechanical analyses are given. Glaciofluvial and glaciolacustrine deposits and raised shorelines of glacial lakes are present. Charts show three sections of Pleistocene stratigraphy, and bedrock contours and locations of wells; water data for drilled and dug wells are summarized in appendixes. The shale is a poor aquifer; 12 percent of all drilled wells encountered salty water. High-capacity wells reach sand and gravel near the bottom of buried valleys, while shallow dug wells tend to go dry. Water levels in an observation well are shown on a chart.—ESL

Watt, W. Stuart. *See* Henriksen, Niels. 01856

Watterson, J. *See* Sutton, J. 01861

01862 **Watterson, Juan.** Plutonic development of the Ilordleq area, South Greenland—Pt. 2, Late-kinematic basic dykes: Medd. om Grönland, v. 185, no. 3, 104 p., illus., tables, geol. map, 1968; *reprinted as* Grönlands Geol. Undersögelse Bull. 70, 1968.

Basic dikes with primary amphibolite facies mineral assemblages were emplaced along active transcurrent fissures in closing stages of plutonic activity. The order of crystallization, from petrographic evidence and composition of filter-pressed fractions, is consistent with consolidation of magma at ca. 4000 bars water pressure at 800–850°C. The calc-alkaline trend of differentiation and high-alumina characteristics of some dikes, illustrated by chemical analyses, is probably the result of fractionation dominated by separation of mafic from felsic phases; this is contrasted with fractionation taking place under conditions of low water pressure. It is capable of producing many characteristic features of the orogenic suite, including large amounts of intermediate differentiates. Oblique foliation in the dikes is related to transcurrent movements and is interpreted by reference to a model of rotational homogeneous strain.—ESL

01999 **Watts, W. A.; Bright, R. C.** Pollen, seed, and mollusk analysis of a sediment core from Pickerel Lake, northeastern South Dakota: Geol. Soc. America Bull., v. 79, no. 7, p. 855–876, illus., table, 1968.

Pickerel Lake formed on the Coteau des Prairies prior to 10,670±140 years ago. The lake was probably initially underlain by an ice block; it was insulated from the ice first by an undetermined thickness of outwash, and then also by sediment. Fossil pollen, spores, seeds, leaves, and mollusks of a core from Pickerel Lake were analyzed to work out the limnological history of the lake and vegetational history of the nearby upland. The data were then compared with ecological data from modern vegetation and the lake. Four pollen zones were established. The top of zone 1 (oldest) is dated by radiocarbon analysis as 10,670±140 years ago, the top of zone 2 is estimated as 8,000 years ago, and the top of zone 3 as 4,000 years ago. Inferred changes in vegetation and ecological conditions are correlated with these four zones.—HMB

02067 **Weidick, Anker.** Quaternary deposits around Holsteinsborg, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 23–24, 1968.

The high outer coastal terrain is cut by an east-west depression around Ikertoq Fjord, which continues offshore as a deep submarine canyon and was a drainage channel for the Inland Ice during the Pleistocene. The highest Quaternary deposits are 110–140 m above sea level. Radiocarbon dates on shells in deposits below 70 m indicate a trend of uplift resembling that described for the Mestersvig area in East Greenland. Ice margin deposits were laid down before the *fjord stages* but later than Wisconsin-Würm moraines of offshore banks; these moraines represent a stage designated the Taserqat stage.—ESL

Weiss, L. E. *See* Paterson, M. S. 01891

Welder, F. A. *See* Coffin, D. L. 02086

07314 **Wellman, Peter.** The aeromagnetic anomalies and the bathymetry of the central part of the Hawaiian Ridge: New Zealand Jour. Geology and Geophysics, v. 10, no. 6, p. 1407–1423, illus., 1967.

An interpretation is given of a total force aeromagnetic survey of an oceanic area limited by lat 22° N. and 25° N. and by long 162° W. and 167°30′ W. The bathymetry is described and is used to infer the geological history. Magnetic anomalies trend east over the Hawaiian Ridge and north–east over the surrounding sea floor. The larger anomalies are caused by normal, or more rarely by reverse, magnetization of the bathymetric features, the smaller anomalies by magnetically anomalous bodies in the Earth's crust. Anomalous bodies in the Hawaiian Ridge are probably serpentinized ultrabasic rocks that lie beneath the volcanic vents, and those away from the Hawaiian Ridge are probably north–east trending intrusions.—Author's abstract

07212 **Wenban-Smith, A.K.** A computer program for determining optical parameters and optical and crystallographic directions directly from universal stage readings: Canadian Mineralogist, v. 9, pt. 2, p. 269–270, 1967.

A computer program has been developed which will calculate the optical parameters $2V$ and $Z \wedge c$ directly from universal stage measurements. The program is coded in FORTRAN IV for IBJOB compiler, IBSYS monitor and IBM 7094–II computer.—MR

01758 **Wentworth, Sally Ann.** An investigation of fine–grained micas with emphasis on their hydrous character [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4260B, 1968.

Werner, E. W. *See* Northrop, John. 01950

01903 **Wetherill, G. W.; Davis, G. L.; Lee–Hu, C.** Rb–Sr measurements on whole rocks and separated minerals from the Baltimore Gneiss, Maryland: Geol. Soc. America Bull., v. 79, no. 6, p. 757–762, illus., table, 1968.

Previous studies of strontium isotopes in minerals from mantled gneiss domes, made before recognition of the importance of strontium redistribution, were interpreted as indicating that radiogenic strontium was retained almost completely by K feldspar in spite of a subsequent orogeny. An isochron plot of new whole–rock samples from gneiss domes near Baltimore, Md., indicates an age of 1050 m.y., in agreement with previous ages reported on K–feldspar and zircon. Primary Sr–87:Sr–86= 0.705. However, measurements on separated minerals show that the values obtained earlier on K–feldspar probably were obtained only because this mineral had nearly the same Rb:Sr ratio as the whole rock. Measurements on plagioclase and K–feldspar, as well as on biotite, now show that extensive strontium redistribution took place in the Baltimore Gneiss as a consequence of the Appalachian orogeny.—Authors' abstract

01921 **Weyl, Peter K.** Precambrian marine environment and the development of life: Science, v. 161, no. 3837, p. 158–160, 1968.

The tropical thermocline must have existed since the ocean's depth exceeded 300 m. The density gradient in this layer concentrated organic aggregates, formed abiologically near the surface of the sea, and the low rates of diffusion across this layer permitted the accumulation of oxygen once the layer was populated by blue–green algae; thus the evolution of eukaryotes became possible within the layer. Because of rapid mixing over the shelves, the eukaryotes were restricted initially to the thermocline over deep water. The shelves could not be permanently inhabited by organisms requiring respiration until the oxygen level of the atmosphere was adequate. At this stage, the swimming Metazoa of the thermocline could adapt to a benthic environment on the shelves by developing exoskeletons.—Author's abstract

01773 **White, D. E.** Ground–water resources of Upton County, Texas: Texas Water Devel. Board Rept. 78, 132 p., illus., tables, 1968.

Water needs of Upton County are supplied entirely from ground water, Trinity Sand being the principal source, and irrigation the principal use. Recharge to the aquifer is roughly equivalent to the amount being transmitted through the aquifer—about 1 mgd. Present pumping is, in effect, a mining operation. Additional development is expected, with water obtained from the 8 million acre-feet estimated to be available to wells; percentage of this water that can be developed is not known, but will depend on construction, spacing, and discharge rates of the wells. Contamination by disposal of oil-field brines may reduce the amount that can be developed for purposes other than water flooding. Water from the Trinity Sand is of calcium magnesium sulfate type; few wells yield water containing less than 1,000 ppm dissolved solids.—*from* Author's abstract

01995 **White, Everett M.; Agnew, Allen F.** Contemporary formation of patterned ground by soils in South Dakota: Geol. Soc. America Bull., v. 79, no. 7, p. 941-944, illus., 1968.

Soils surface patterns (gilgai) described in the soils literature seem analogous to stripes and nets described as frozen-ground patterns in the geologic literature. Gilgai patterns in South Dakota, however, display soil profiles which show that the pattern is not relict but is forming today. It is important that patterned soils be described accurately and that the age of the site, its moisture regime, and soil texture be determined before one may conclude whether the pattern is relict or is actively being formed. To differentiate patterned ground forming in warm climates from that in cold climates we propose that the gilgai nomenclature of Hallsworth and others (1955) be used for the former, and that of Washburn (1956) for the latter.—*from* Authors' abstract

01887 **White, George W.** Age and correlation of Pleistocene deposits at Garfield Heights (Cleveland), Ohio: Geol. Soc. America Bull., v. 79, no. 6, p. 749-752, illus., 1968.

Radiocarbon dates and new exposures in the Mill Creek Valley in Garfield Heights, just southeast of Cleveland, Ohio, now permit a revised correlation of the Pleistocene deposits. Illinoian gravel is overlain by thick paleosol, Sangamonian in age. Above the paleosol is "Lower loess," 4 feet thick, fossiliferous in the lower calcareous part, and late Altonian in age; it is overlain by calcareous, fossiliferous "Upper loess," 2.5 feet thick, dated 28,195±535 yr B.P. and therefore early Farmdalian in age. Above this is pro-Kent lacustrine silt and clay with beetle fragments; wood in the lowest part is dated as 24,600±800 and 23,313±391 yr B.P. Kent Till overlying the lacustrine material is therefore about 23,250 yr B.P. and thus earliest Woodfordian. Hiram Till, later Woodfordian, overlies the Kent Till and is the surface material.—Author's abstract

White, John S., Jr. *See* Leavens, Peter B. 07240

02136 **White, N. B.; Orr, J. B. B.** Fort Saskatchewan gas field, Alberta, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 713-720, illus., table, 1968.

The Fort Saskatchewan gas field, discovered in 1951 in central Alberta 15 mi northeast of Edmonton, has a total of 31 gas wells which had yielded 87,097,346 Mcf of sweet nonassociated gas as of January 1, 1966. Production is from the Viking Formation of Early Cretaceous age. A stratigraphic trap is formed by the updip pinchout of the productive sandstone; downdip the sandstone body is water-saturated, and it is terminated laterally by shale re-entrants along strike.—Authors' abstract

White, Natalie D. *See* Arteaga, F. E. 01879

White, W. B. *See* Moore, R. K. 07189

Whittig, L. D. *See* Baldar, N. A 01851

Wier, K. L. *See* James, H. L. 01692

Wilkins, James G. *See* Osmond, John C. 02108

07235 **Wilkins, R. W. T.; Ito, Jun.** Infrared spectra of some synthetic talcs: Am. Mineralogist, v. 52, nos. 11–12, p. 1649–1661, illus., tables, 1967.

The spectra of talcs in which Mg(II) is wholly or partly replaced by another divalent ion have been investigated in some detail in the hydroxyl stretching region. Intensity relationships between the four bands observed are consistent with a random distribution of the magnesium and substituting ion between the two crystallographically distinct octahedral sites. Bandwidths depend on the ionic radius and concentration of the substituting ion. Both factors, when superimposed on the characteristic splitting parameters of any ion, are also shown to have an appreciable effect on the frequency separation between the four observed bands. Spectra of synthetic Mg–Ni talc series and their bearing on the assignments of the lattice vibrations is also discussed.—*from* Authors' abstract

01939 **Williams, Roy E.** Ground water flow systems and related highway pavement failure in cold mountain valleys: Jour. Hydrology, v. 6, no. 2, p. 183–193, illus., 1968.

In valleys where precipitation is high in adjacent mountains, the valley floor is often a ground-water sink and the mountains contain ground-water sources. Upward movement and near-surface lateral flow are characteristic of ground water beneath the valley floor. Optimum conditions for growth of ice lenses beneath highway pavement consist of a frost-susceptible soil, a source of water, and absence of high negative pore-water pressures. Ice lenses may become unusually thick in cold valley areas characterized by ground-water discharge or near-surface lateral flow. Pavement in such areas may be subjected to much more severe frost heaving than are sections overlying zones of deep lateral ground-water movement or recharge.—GDC

07182 **Williams, S. A.; Anthony, J. W.** Hemihedrite, a new mineral from Arizona [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 310, 1967.

01792 **Wilson, Charles W., Jr.** Mineral resources summary of the Daniels Landing quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 5 p., 1968.

This summary accompanies Tennessee Div. Geology Geol. Map GM 31-SW by C. W. Wilson, Jr. and Gerald K. Moore (cited separately). The only mineral resource mined in the Daniels Landing quadrangle is chert from two inactive pits in the Fort Payne Formation which is widely exposed and has a maximum thickness of about 300 feet. Potential resources include limestone from the Decatur Limestone, sand and gravel from alluvial deposits in the flood plains of larger streams, and white phosphate from several formations.—MCM

01800 **Wilson, Charles W., Jr.; Moore, Gerald K.** Geologic map of the Daniels Landing quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 31-SW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Daniels Landing quadrangle, Tennessee," by C. W. Wilson, Jr., is cited separately.—MCM

01835 **Wilson, Stanley D.; Marano, David.** Performance of Muddy Run Embankment: Am. Soc. Civil Engineers Proc., v. 94, paper 6026, Jour. Soil Mechanics and Found. Div., no. SM 4, p. 859–881, illus., 1968.

A 250-ft earth and rockfill dam was built across the gorge of Muddy Run on the Susquehanna River, near Holtwood, Pa. The only rock encountered during site exploration was Precambrian Wissahickon Schist, weathered for 100 feet below the surface except in the valley; this formed the foundation and was used for compacted rock fill. Joints and foliation were factors in the decision to line the intake canal with concrete. Maximum compression of the rockfill was over 8 percent compared with 2 percent for the compacted core of soil. Significant upstream and downstream movements developed in the rockfill shells during construction and filling, but post-construction movements have been small. In-situ torsion shear tests were performed

on the micaceous schist before construction and large-scale field direct shear tests on the compacted rockfill.—ESL

07183 **Winchell, H.** A computer program concerned with statistics of rock fabrics [abs.]: Canadian Mineralogist, v. 9, pt. 2, p. 310, 1967.

02069 **Windley, B. F.** New field relations from the early Precambrian of West Greenland, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 27–31, 1968.

New field relations found in five areas between Ravns Storö and Sukkertoppen are described. All regions in southwestern Greenland, with two exceptions, have the same three-fold chronology: layered calcic anorthosites associated with norites, followed by granulite facies metamorphism, followed by amphibolite facies metamorphism. In the Ravns Storö area, there is a belt of greenschist facies rocks, lying between regions that have been up to granulite facies. In the Godthaab area, the main amphibolite belt contains well-preserved pillows while adjacent gneisses contain multiple fold interference patterns. In later dike swarms, the wider ones are layered with dolerite outside, amphibolite in the center, and various gabbros between the two.—ESL

07269 **Wise, O. A.; Caplan, W. M.** Silurian and Devonian rocks of northern Arkansas, *in* Symposium—Silurian-Devonian rocks of Oklahoma and environs: Tulsa Geol. Soc. Digest, v. 35, p. 242–252, illus., 1967.

The rocks are widespread in the subsurface, the greatest thickness being 480 feet in Pope County; the thickening may continue into the Ouachita region. Outcrops are limited to the Springfield Plateau area where exposures are poor. No single formation is extensively developed, although the Chattanooga Shale is rather extensive in the northwest, and the St. Clair Limestone in the northeast. The regional structural strike is generally east-west, with the dip to the south. The dip angle is slight in the Ozarks and steepens toward the south.—*from* Authors' abstract

Witherspoon, P. A. *See* Freeze, R. Allan. 01849

01781 **Wood, Gordon H., Jr.; Kehn, Thomas M.** Geologic map of the Swatara Hill quadrangle, Schuylkill and Berks Counties, Pennsylvania: U.S. Geol. Survey Geol. Quad. Map GQ-689, scale 1:24,000, sections, 1968.

01782 **Wood, Gordon H., Jr.; Kehn, Thomas M.** Geologic map of the Pine Grove quadrangle, Schuylkill, Lebanon, and Berks Counties, Pennsylvania: U.S. Geol. Survey Geol. Quad. Map GQ-691, scale 1:24,000, sections, 1968.

01783 **Wood, Gordon H., Jr.; Trexler, J. Peter.** Geologic map of the Tremont quadrangle, Schuylkill and Northumberland Counties, Pennsylvania: U.S. Geol. Survey Geol. Quad. Map GQ-692, scale 1:24,000, sections, 1968.

01784 **Wood, Gordon H., Jr.** Geologic map of the Tower City quadrangle, Schuylkill, Dauphin, and Lebanon Counties, Pennsylvania: U.S. Geol. Survey Geol. Quad. Map GQ-698, scale 1:24,000, sections, 1968.

Wood, Gordon H., Jr. *See* Trexler, J. Peter. 01785

Wood, Gordon H., Jr. *See* Trexler, J. Peter. 01786

Woodford, A. O. *See* Gilluly, James. 01772

02138 **Workman, L. E.** Carbon gas field, Alberta, *in* Natural gases of North America—Pt. 2, Natural gases in rocks of Mesozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 1, p. 726–730, illus., table, 1968.

The Carbon gas field is in a north-northwest-trending lenticular quartz sandstone body in the lower part of the Mannville (Blairmore) Group of Early Cretaceous age at the depth of the "Glauconitic Sandstone," or Bluesky Member of the Clearwater Formation, in south-central Alberta. The sandstone ranges from 20

to 82 ft in gross thickness. Regional dip is westward. The pool is contained in a stratigraphic trap. Sandstone thickness and porosity decrease eastward. A normal fault, with approximately 30 ft downward displacement on the east side, borders the eastern edge of the field. The thickness of sandstone above the gas–water contact is as much as 46 ft. Reserves are estimated to be 124.1 billion cu ft of sweet gas.—Author's abstract

02079 **Wright, H. E., Jr.; Osburn, W. H.** (editors). Arctic and alpine environments—Internat. Assoc. Quaternary Research, 7th Cong., Boulder–Denver, Colo., 1965, Proc., V. 10: Bloomington, Ind., and London, Indiana Univ. Press, 308 p., illus., tables, 1968.

An understanding of present arctic and alpine environments is essential to the reconstruction of the glacial and periglacial processes and events of the Quaternary Period. Arctic (north of the tree line) and alpine (above the tree line) regions have long been considered so similar as to constitute an environmental unit. Critical comparison between the two environments, however, shows many differences, as demonstrated in the 21 papers of this volume, which were presented in a symposium on arctic and alpine environments. Five papers pertaining to geology and ecology in North America are cited separately; senior authors are R. S. Hoffman, J. C. F. Tedrow, L. A. Viereck, J. Major, and D. S. Simonett.—VMJ

Wuestner, C. E. *See* Nichols, P. H. 02156

07185 **Yong, Raymond N.** On the relationship between partial soil freezing and surface forces, *in* Physics of snow and ice—Internat. Conf. on Low Temperature Science, Sapporo, Japan, 1966, Proc., V. 1, Pt. 2: Sapporo, Japan, Hokkaido University, p. 1375–1385, illus., table, 1967.

This paper examines the relationship between unfrozen water in frozen soil resulting in the overall phenomenon of partial soil freezing, and the consequent mechanical performance of frozen soil under external constraints. The energy relationships may be described as surface force effect, and in particular as adsorption and capillary effects. Relations are drawn describing unfrozen water content as a function of moisture potential and persisting subfreezing temperature. In considering strength of frozen soils, it is seen that actual ice content can be used to relate strength with temperature. The frost heaving problem is examined analytically on the basis of ice–water relationships and existent multicurvatures at the ice front. Comparisons are made between measured and predicted frost heaving pressures.—*from* Author's abstract

Yost, S. W. *See* Dryden, J. E. 02104

02023 **Youd, Thomas Leslie.** The engineering properties of cohesionless materials during vibration [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 11, p. 4570B–4571B, 1968.

01753 **Zaitzeff, James Boris.** Taxonomic and stratigraphic significance of dinoflagellates and acritarchs of the Navarro Group (Maestrichtian) from eastcentral and southwest Texas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 10, p. 4178B, 1968.

01922 **Zen, E-an; Mamay, Sergius H.** Middle Pennsylvanian plant fossils—Problematic occurrence in the Bronx: Science, v. 161, no. 3837, p. 157–158, illus., 1968.

A possible glacial boulder of undeformed and unmetamorphosed siltstone containing Middle Pennsylvanian plant fossils was recovered from the Bronx. The rock cannot be explained by known geologic relations and suggests the possibility of unchecked outliers of Pennsylvanian rocks in the Hudson valley.—Authors' abstract

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